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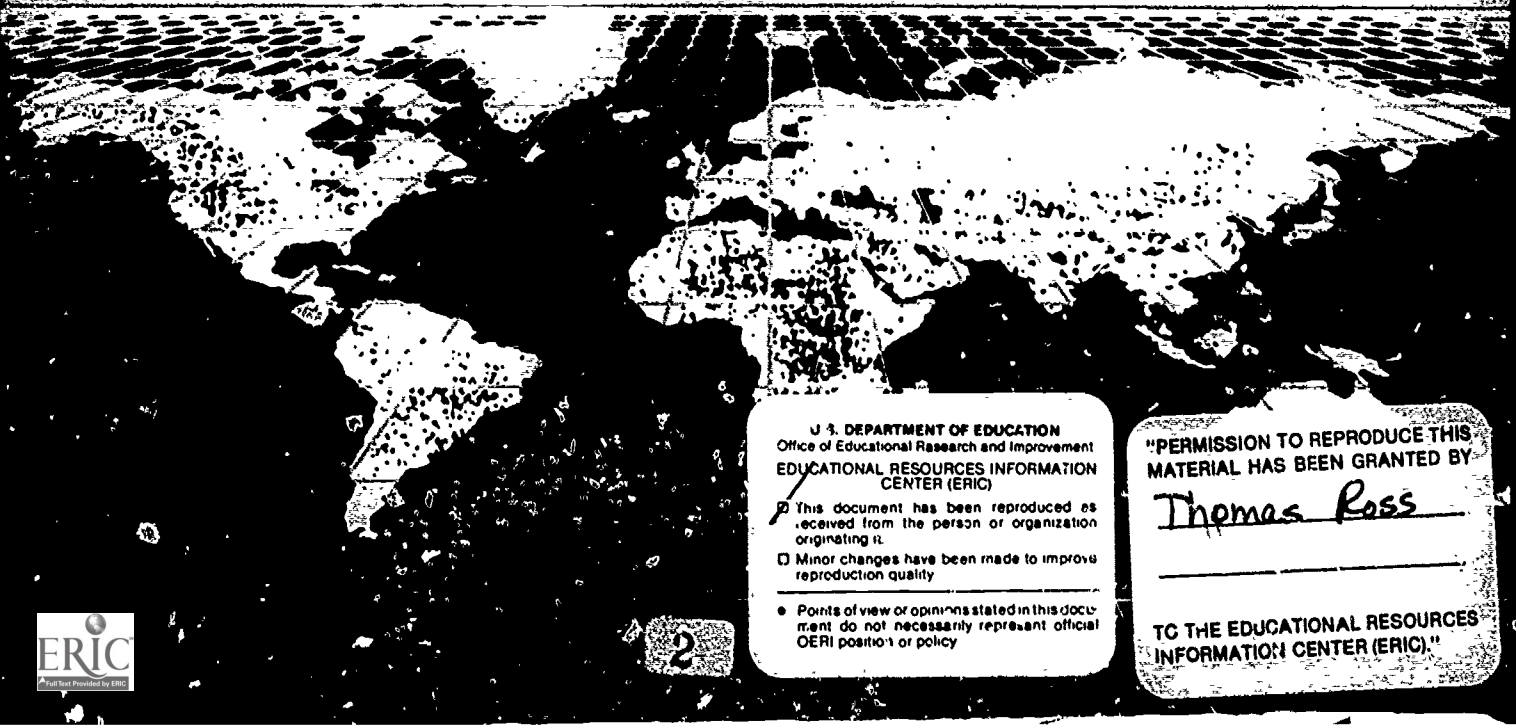
ABSTRACT

One of today's most promising and least costly interactive distance learning systems is audiographics--the combined use of voice transmission, computer networking, and telefax transfer of materials. This handbook is a guide for educators interested in developing an audiographics program. Section I looks at reasons why both rural and urban educators have turned to audiographics and the ways it is used in different school settings. Section II compares features and costs of two-way television, one-way television with audio return, and audiographics. Section III describes audiographics hardware and software, system capabilities and suggested accessories, and software systems marketed by vendors. Section IV outlines steps in procuring and installing an audiographics systems, emphasizing the importance of installing a complementary telephone system. Section V offers advice from teleteachers and school administrators on how to set up school schedules and teacher training for audiographics. Section VI lists some teaching strategies that audiographics users have found effective, and gives examples of materials created by teleteachers. Section VII looks at distance learning's future. Appendices contain a glossary of major technology terms, evaluation data about the effectiveness of audiographics, addresses of distance-learning educators willing to be resource persons, and prices and vendors of audiographics hardware and software. (SV)

Audiographics Distance Learning:

A RESOURCE HANDBOOK

FAR WEST LABORATORY



Audiographics Distance Learning: A Resource Handbook

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September 1990

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Far West Laboratory for Educational Research and Development serves the four-state region of Arizona, California, Nevada, and Utah, working with educators at all levels to plan and carry out school improvements. The mission of FWL's Rural Schools Assistance Program is to assist rural educators in the region by linking them with colleagues; sharing information, expertise, and innovative practices; and providing technical assistance to build local capacity for continued self-improvement. For further information contact Stanley H. L. Chow, Director, Rural Schools Assistance Program, FWL, 1855 Folsom Street, San Francisco, California 94103, (415) 565-3000.

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Introduction

For some, the term distance learning (DL) still conjures up old images of educational television: students packed around a TV screen, while a "talking head" dispenses information. Now with the development of more sophisticated technologies in the 1980s, distance learning is taking new interactive forms that let teachers hear as well as speak to, and even see, students at remote locations. Educators are discovering that when designed and implemented well, live, two-way instruction across long distances can expand curriculum, stretch budgets and broaden student horizons, improving both teaching quality and student performance.

This resource handbook focuses on one of today's most promising, and least costly, interactive DL systems: audiographics. Audiographics is the combined use of voice transmission, computer networking, and telefax transfer of materials. Teacher and students hear but do not see each other. Besides speaking to the receiving classes, the instructor can use a digitized drawing pad and a keyboard to "draw" on a computer monitor screen; the image immediately appears on students' screens at the receiving sites. Students, in turn, use their own drawing pad and keyboards, as well as a speaker phone, to interact with the teacher. Often, a facsimile machine is added to provide rapid transmission of paper "hard copies" of tests, hand-outs, and other materials.

Based on what has been learned from pioneering efforts in a variety of settings, this handbook is a step-by-step guide for educators interested in developing an audiographics program. Section I looks at the reasons why educators turned to distance learning and at the ways DL is used in different school settings. Section II describes the different DL systems available, focusing on what distinguishes audiographics from other distance learning options. Section III describes the software and hardware used in audiographics, summarizes system capabilities and suggested accessories, and explains software systems marketed by vendors. Section IV outlines the steps involved in procuring and installing an audiographics system, emphasizing the importance of installing a telephone system that complements your system's capabilities. Section V offers advice from teleteachers and school administrators on how to set up school schedules and teacher training for audiographics. Section VI lists some teaching strategies that audiographics users have found effective, and gives examples of materials created by teleteachers. Section VII looks at distance learning's future.

In Appendix A you'll find a glossary of the major technology terms used. Appendix B summarizes existing evaluation data about the effectiveness of audiographics DL. Appendix C lists addresses of educators who use audiographics or other DL systems and are willing to share their knowledge. Appendix D lists the prices of operating software and supporting technology when permission to print this information has been granted by the vendor.

I. An Overview Of Audiographics Distance Learning

A school in an isolated Western desert community faced a dilemma: students wanted to study biology, but their one-room school lacked sophisticated lab facilities and an experienced science teacher. The solution? An audiographics distance learning hook-up that allowed students to join a biology class with a veteran teacher at a school site 150 miles away. Across the country, a large urban school district faced a similar problem. Competing with the expanded curricula of neighboring private schools, the district wanted to offer advanced calculus. But there weren't enough students at any individual site to make the course cost-effective. When this district too turned to audiographics, an instructor was able to teach calculus to 11 students in his own classroom and, simultaneously, to students gathered at two other schools. The district's new instructional delivery system is now used to offer other specialized courses as well.

Why Audiographics?

Collective experience to date confirms what developers and proponents of audiographics distance learning (ADL) claim: the system is a cost-effective way for both rural and urban schools to supplement their curricula with needed instruction. In contrast to other distance learning systems, ADL's equipment costs are well within the financial reach of most schools Both its hardware and software packages are relatively simple to operate, meaning that schools themselves can program what is to be transmitted to remote sites. And students at remote sites receive needed courses they otherwise wouldn't get. In short, ADL is a highly effective delivery system that can enable schools to provide quality educational programs when other resources and trained personnel are not available.

A Boon to Rural Schools

Today's society demands better performance by the nation's students and schools, with access for all to broader, more rigorous curricula. Rural schools, serving over 30 percent of U.S. youths, are especially constrained in meeting these demands. They tend to experience severe limitations in staff and resources due to geographic isolation and small size. Rural administrators struggle to attract qualified teachers in highly specialized subject areas; at the same time, there often

aren't enough students to make specialized classes economically feasible. Dennis Jensen, Superintendent of Elk Point Public Schools in rural South Dakota, faced just this kind of situation. "Adding more electives in the traditional way was not plausible for us," he says. But like a growing number of rural administrators, "we found our solution in audiographics." Rural teachers, similarly pleased with the curricular expansion ADL allows, also like the changes it makes in their jobs. For many, ADL brings some relief from the burden of preparing daily lessons in several subject areas for students in multiple grades. Others cite a new outlet for creativity—which works to student advantage. A biology teleteacher in rural Utah, for example, organized an audiographics debate on the benefits and drawbacks of radiation. Students at each of his two receiving sites prepared arguments and debated "over the air"—a rare treat for students with few classmates their own age.

Urban Pluses

With growing community needs, urban schools need to accomplish more with already inadequate budgets. Some feel they are losing students to private schools due to their inability to provide a comparable number of specialized courses. Others, like their rural counterparts, feel burdened by the expense of advanced subject classes with small enrollments. Foreign language instruction is especially hard hit by the budget crunch. To address these issues, numerous schools are offering a greater array of languages or providing Advanced Placement language courses by using audiographics. One result these schools report is a dramatic increase in the number of students studying foreign languages.

A Brief History of ADL

One reason why audiographics works so well for schools is because it is the one form of distance learning that was developed by educators for educational use. Specifically, it was created as an answer to the special needs of small, sometimes remote, rural schools. The first audiographics system was piloted in Utah in the early 1980's by a rural school superintendent and one of his teachers. His idea was to link students in his district's four remote high schools with a trigonometry instructor in a community college some 140 miles away. When the high school students did as well on tests as students at the

college, many other educators in both rural and urban settings nationwide became interested in this "telelearning" approach. The next step—which again happened in Utah—was linking rural schools with urban schools. In the mid-1980's, two physics professors at the University of Utah used specially developed ADL software to transmit Advanced Placement Physics from the university to two of the state's high schools: one in a nearby urban district, the other in a remote, rural district. Soon other Utah schools expanded the concept by forming a teleteaching group that linked together a northeastern Utah vocational training center, (a Utah State University satellite instructional center) and several school districts. Though focused on improving the delivery system, this group eventually increased its curricular offerings to a full-day schedule of seven classes. As audiographics began to catch on around the country, networks have organized in a variety of ways. One of the most common involves districts collaborating with neighboring districts—a practice particularly well-suited to rural districts that are not geographically isolated but include only a few schools. In many cases, universities and state agencies have helped foster such collaborations. For example, educators from Mansfield University in Pennsylvania and the Pennsylvania State Department of Education oversaw the development of improved software and appropriated state funds to procure equipment and establish telelearning sites. Today, more than 50 public schools and colleges in Pennsylvania are sending and receiving instruction via audiographics. Realizing the potential of distance learning, Mansfield University has incorporated teleteaching into its teacher training program, developing a special training laboratory and origination site for instruction. Students seeking teaching certificates from the College of Education must take a course that involves student teaching over the audiographics delivery system, which links the university with one school district in North Dakota and another in Utah. Thus far, nearly 200 students have completed the Mansfield program, dubbed "The Continental Classroom."

Current ADL Users

Schools and districts in Alabama, Alaska, Arizona, the Dakotas, Florida, Louisiana, Nevada, New York, Pennsylvania, Texas, and Utah are currently operating telelearning systems; many of these are rural, but some are urban districts such as

the Dade County School District of Miami, Florida. (See Appendix C for more information on national teleteaching site locations.)

U.S. schools are also pioneering audiographics transmission to school sites in Mexico and Japan, giving students a chance to practice their new language with native speakers, learn another culture firsthand, and have sometimes eye-opening exchanges with peers in different geographic, economic, and social settings. A group of high school students in the small, rural town of West Sunbury, Pennsylvania, began ADL transmission with a high school English class in Juarez, Mexico. Their stereotyped view of the poor and rundown Mexican high school was abruptly revised when the students saw that the school in Juarez had classrooms and educational materials far more sophisticated than their own.

II. Examining Distance Learning Options

The many types of distance learning technologies differ in the capabilities they offer, the equipment required, and the price tag for obtaining and operating the system. In order to determine which system best matches your district's financial resources and curricular objectives, it is crucial that you become familiar with available options. The three most widely-used distance learning systems are: two-way television, one-way TV with audio return, and audiographics. For visual illustrations that compare these systems see pages 11, 12 and 13. Unlike broadcast instructional television, none of these requires expensive program development. While each allows students to communicate with the teacher, they differ in cost, ease of operation, and degree to which they approximate a live classroom.

Two-Way Television

This option, the costliest and most complex to operate and maintain, comes as close as is currently possible to bringing teacher and students into the same classroom. Each site in a two-way TV system resembles a little TV studio, with camera, microphones and monitors. Activities at each site are transmitted simultaneously, so teachers and students across a wide area can see and hear each other "live." Because it closely simulates a normal classroom, two-way TV is suitable for virtually all kinds of instruction.

Two-way TV's relatively high cost increases dramatically with increased distance between sites. If transmission is by microwave and the terrain is rough, costs rise further. As a result, current use of the two-way option is confined to sites within small geographic areas. The sophistication of the technology also makes two-way TV the most difficult of the three options to operate and maintain. It is the most prone to technical problems; an engineer or well-trained technician should be on-call if not on-site. Some school districts enter a maintenance contract with a cable, utility or local broadcast company. Each site requires cameras, microphones, TV monitors, and other hardware to mix, code, send, receive, and decode signals. The signals can be transmitted over coaxial cable, fiber optics, microwave, broadcast (including low-power television and satellite), or a combination of these. To take full advantage of the strengths of this system, teachers need to be thoroughly trained in its possibilities. (See Appendix C for some locations where two-way television has been implemented.)

One-Way Television with an Audio Return

Less costly than two-way TV, one-way TV with audio return resembles traditional educational television, except that students can interact with the teacher and students at other sites by telephone or radio. The students at remote sites can see the teacher on their television monitor, but the teacher cannot see them. Students can ask questions by phone or FM radio during class. Both the inquiry and the teacher's answers may be broadcast, although the large networks that distribute courses nationally use teaching assistants to help handle the large volume of student questions. The system can gain increased interactivity by telefaxing "hard copy" materials and using other computer enhancements. With its visual component, one-way TV can work effectively for large-group instruction featuring teacher presentations as well as small-group instruction.

Costs for setting up receiving sites are relatively low. You will need a TV and telephones and perhaps a satellite or microwave receiving station. However, when schools develop broadcasting capacity, costs rise dramatically. At originating sites, maintenance requires the same technical expertise and training as two-way TV. (See Appendix C for locations where one-way TV systems have been implemented.)

Audiographics

To reiterate, audiographics combines interactive voice transmission with computer networking and telefax transfer of materials. Teacher and students hear but do not see each other. The absence of live two-way visual contact puts a great premium on attractive graphics presentations by the teacher to maintain student attention. Both teacher and students can use digitized drawing pads and keyboards to create images on a computer monitor screen that immediately appear at the other's site. ADL is the least costly and simplest of the three distance learning options, but the feature that makes audiographics distinctive is that both audio and visual signals are sent over telephone lines as data.

Visual aids can be prepared by the teleteacher before class, stored on disk and called up as needed, or can be created as the lesson progresses. Some districts have supplemented their

system with slow-scan TV, which will send fixed visual images (still pictures) over the same phone line that carries voice and data. A new technology, video disc players, can be added at each site that will allow the integrated use of commercially prepared visuals, upon command by the teleteacher. Most districts are adding facsimile machines, which provide rapid transmission of paper "hard copies" of tests, hand-outs, and other materials.

Comparing Costs

For a minimal two-way TV system, ballpark figures for initial installation start at around $14,000 per site. But studio construction and equipment for the central broadcast site start at about $35.000. Long distance transmission costs range from $6,000 per mile for fiber optics to $25,000 per 20-mile microwave hop and $85,000 per 50-mile hop. For one-way TV, receiving site costs are under $1,000, but fees paid to a central broadcast studio must also be added to the cost. Distance will not affect costs for one-way TV significantly within the signal

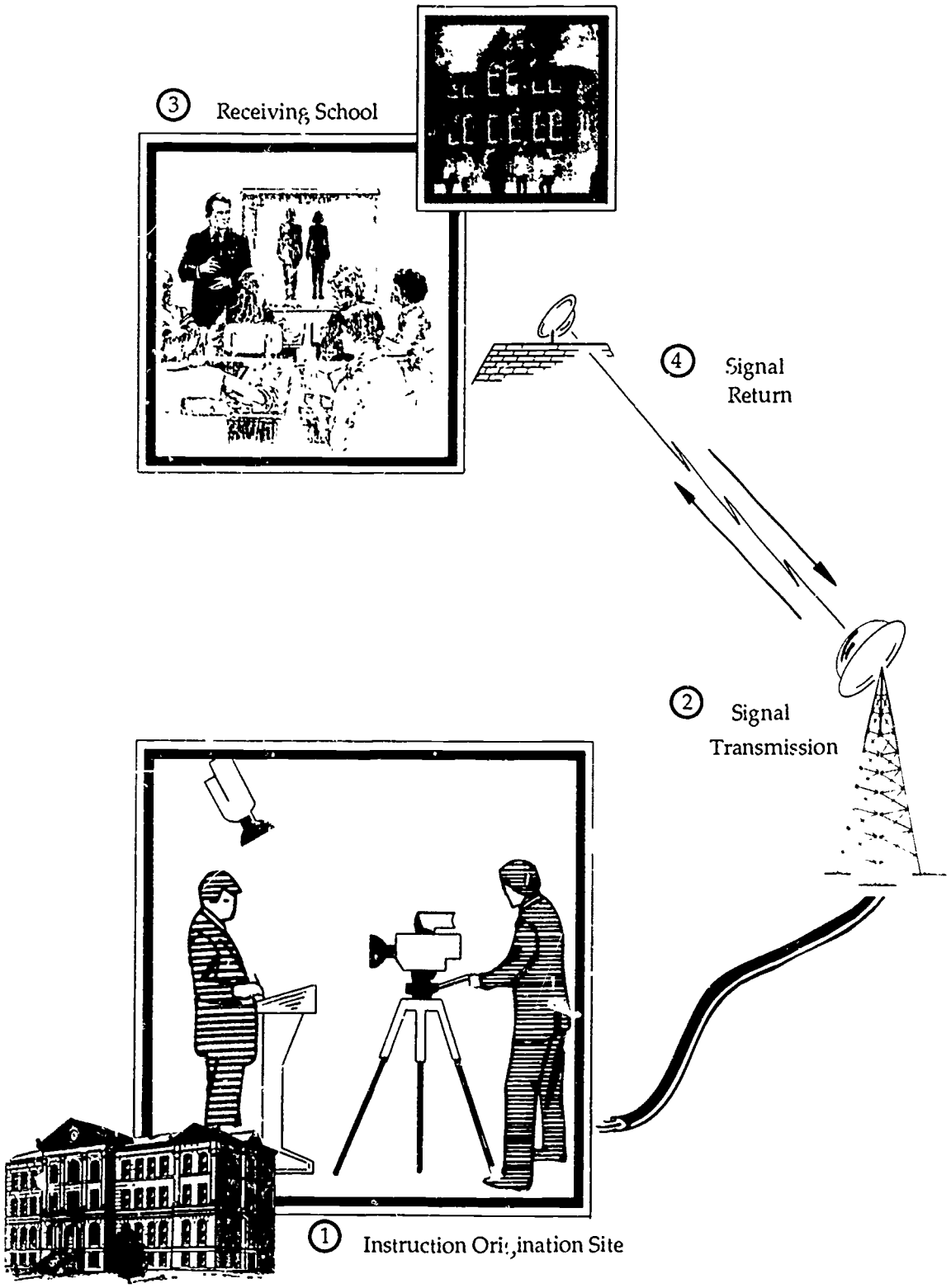
Table 1
Cost Comparisions for Three Distance Learning Techniques

	Audiographics	One-Way TV	Two-Way TV
Start-Up (per site)	$6,000	origination site: $30,000 receiving site: $500+	$25,000
Signal Transmission	14c/hr. (phone line)	$150/hr. (broadcast)	$25,000-$85,000 (microwave) $4,000 per mile (coaxial cable) $6,000 per mile (fiber optics)
Annual Maintenance	$250/yr	$1,200/yr.	$1,600/yr.

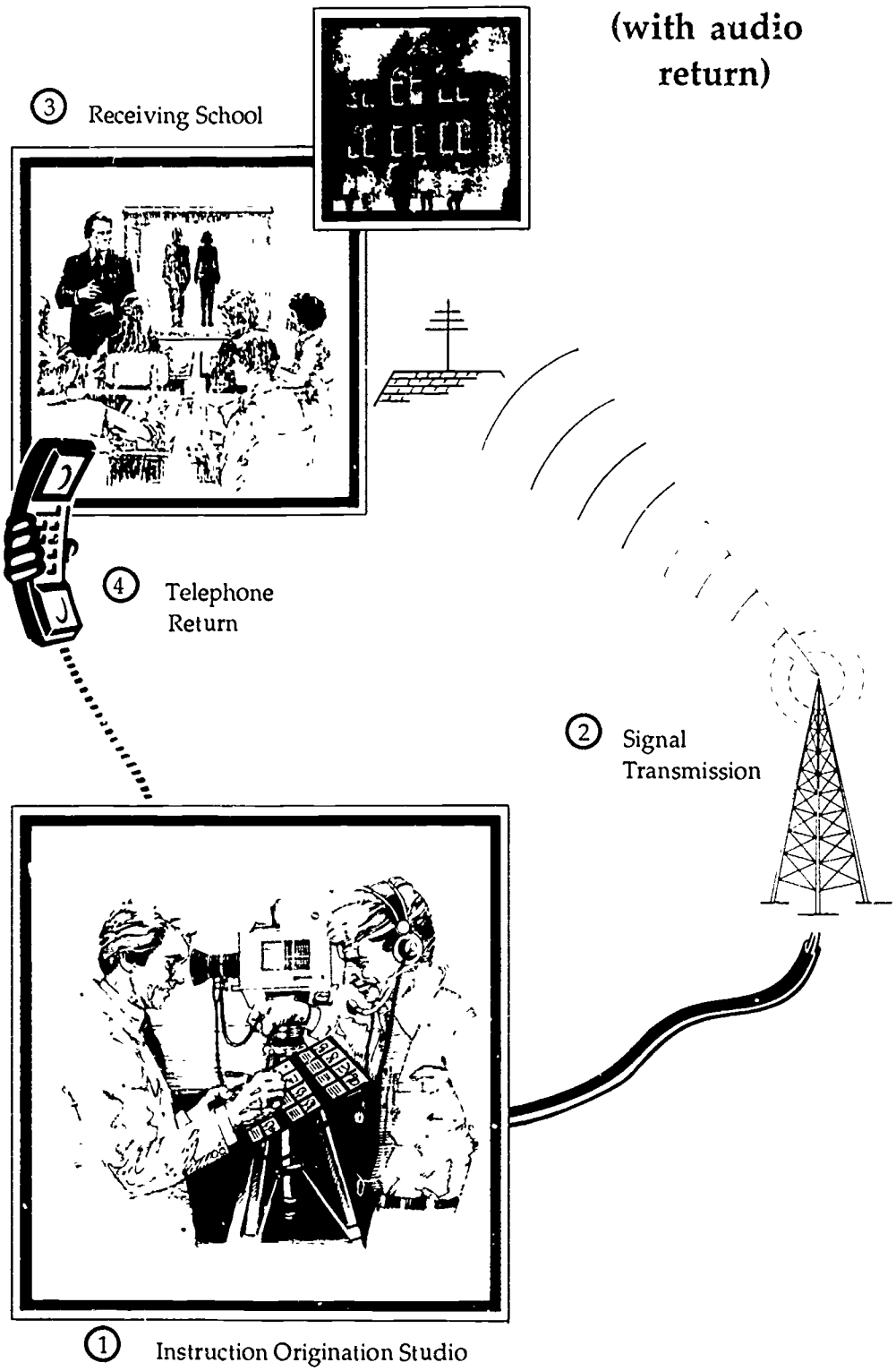
area. Audiographics installation runs about $6,000 per site. Distance may affect signal quality and the number of sites served simultaneously. Daily operating costs are tied to long-distance telephone rates. One rule of thumb for all these delivery systems: annual maintenance and repair will cost approximately 4% of initial installation.

Unquestionably, audiographics is the most economical DL delivery system. It is the least expensive to install, can use equipment such as computers or modems that the school site may already have, and is easy and inexpensive to maintain. It is highly cost-effective for small group instruction, especially in remote rural areas, since it does not require heavy funding from sources outside the school district.

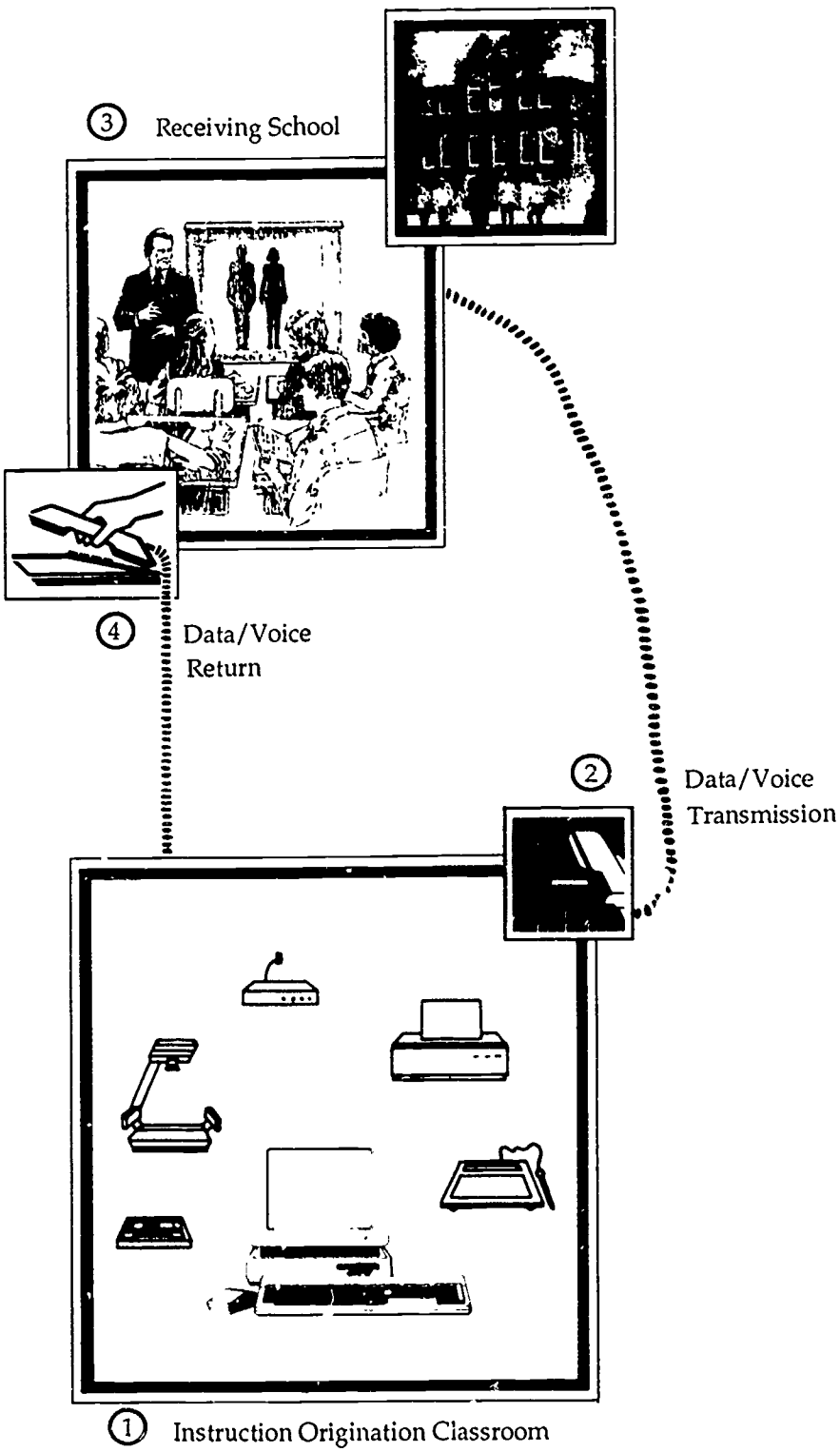
Two-Way TV Distance Learning System



One-Way TV Distance Learning System (with audio return)



Audiographics Distance Learning System



III. Audiographics Hardware And Software

Let's now take a look at the basic workings of the audiographics system. First, this section explains the manner in which the system operates. It describes the different software and hardware components involved in an audiographics system. It goes on to describe the basic functions that an audiographics system performs. Finally, it offers detailed descriptions of software packages available from various vendors, and the different pieces of hardware that these software packages operate. (When a given software package will only operate one specific brand of equipment, we include that equipment's brand name.)

Understanding the Audiographics System

An audiographics delivery system can be thought of as analogous to the human body. Just as the brain controls the nervous system, which "commands" the limbs to perform varied functions, audiographics system software commands its hardware to create, store, retrieve, transmit, receive, listen or view graphics, voice or documents. "Software" is a computer program stored on a floppy or hard disk. (A glossary of terms is included in Appendix A.) Audiographics "hardware" may include any of the following:

Hardware for Visual/Graphics Creation

In addition to a computer equipment for visual/graphics creation include the following:

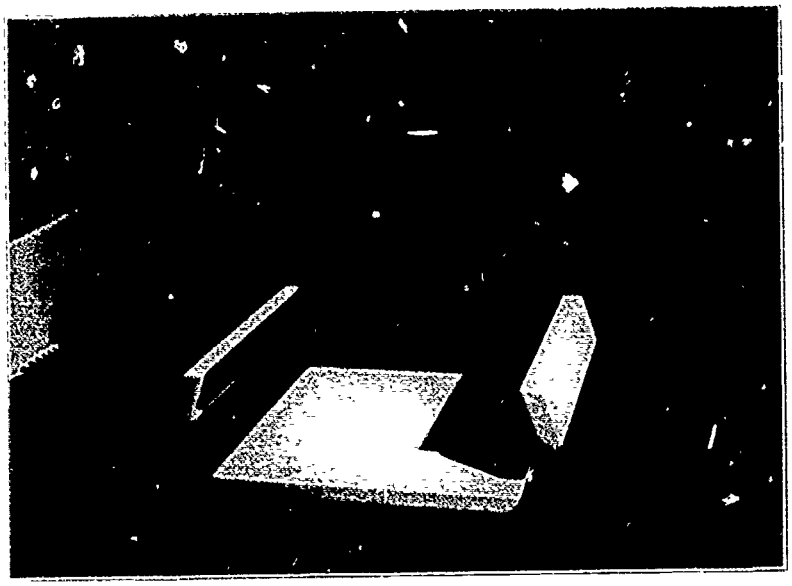
Computer Monitor—a device very similar to a TV that displays information, visuals and graphics received from a computer through a short cable or over a phone line.

Mouse—a small hand-maneuvered tool that sends commands to a computer. It performs many of the functions of a keyboard, but often much more rapidly and easily because it instantaneously moves the cursor to any desired location. A mouse can be used as a drawing instrument to develop creative graphics.

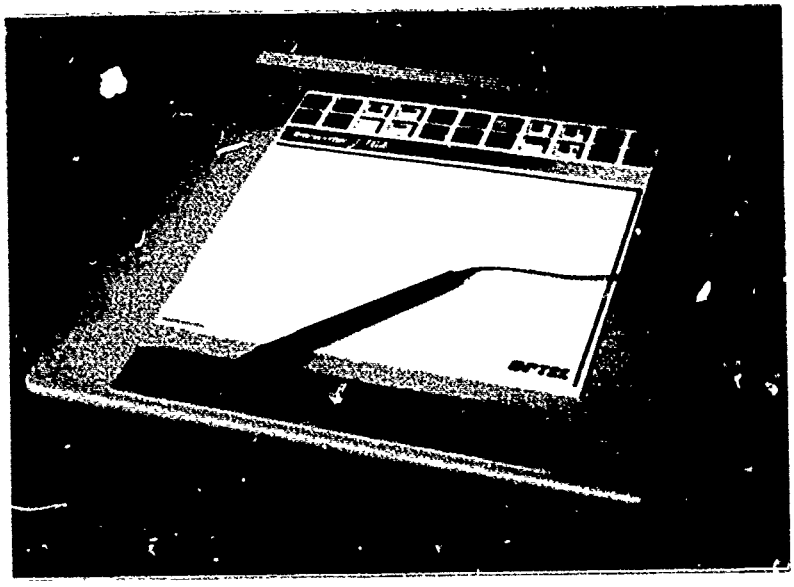
Video Camera with Digitizer—a video camera, essentially the same type used to tape home videos, with a device that receives the pictures from the camera and converts or digitizes

them into data to be processed by the computer. In other words, images are "captured" as still pictures, processed, and used like other computer graphics.

Scanner—a device that can copy documents and objects in much the same way that a photocopy machine operates. However, the images are "digitized" (converted into data) and sent to a computer to be processed as information, eventually to be displayed on a computer monitor.



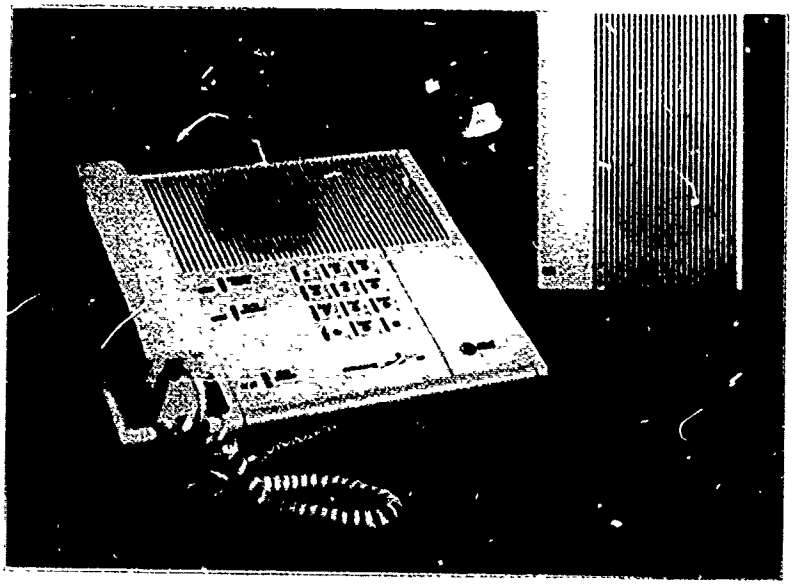
Digitized Drawing Tablet—a device or tablet that when drawn or written upon (similar to a chalkboard), converts or digitizes the material into data and sends it to the computer in much the same fashion as a mouse.



Hardware for Audio Creation

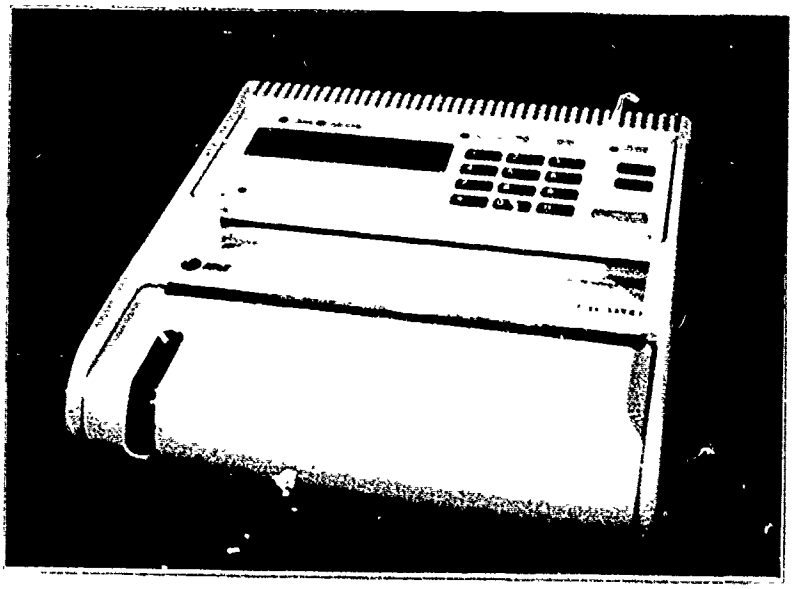
In addition to a microphone is the following:

Speaker Phone—a telephone with a built-in microphone/ speaker system.



Hardware for Copy Creation

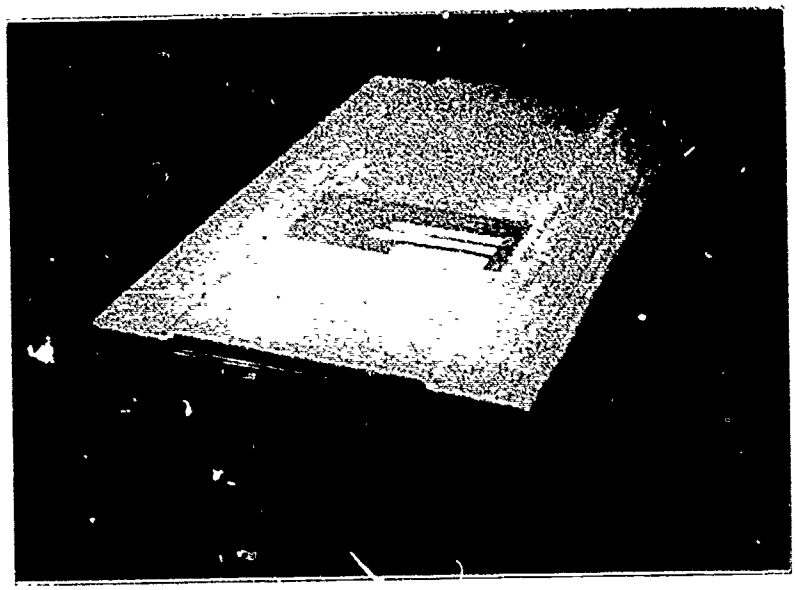
Facsimile or Fax Machine—a device that scans and copies information and graphics from paper and sends this material as data over a phone line to a receiving fax machine.



Computer Printer—to convert computer data (information and graphics) into printed form on paper.

Hardware for Transmission

Modem—a device that converts computer data output from digital to a form that can be transmitted over a telephone line. A modem, when it receives data via phone line, converts the data back to digital form to be processed by a computer.



Voice/Data Modem—a device that sends and receives voice and data simultaneously over the same phone line.

Basic Functions of the Audiographics System

No matter what course is taught via audiographics, the system's software will support the same three basic interactive functions:

- visuals/graphics delivery
- audio transmission
- hard copy delivery

The visuals/graphics function allows the teleteacher to transmit drawings or diagrams during the lesson. These graphics can be transmitted through a variety of hardware systems (described later in this section). In general, the teacher has the option of transmitting graphics, either prepared in advance as "slides" or created on the spot.

A Basic Audiographic Distance Learning System

Left to right: telephone and speaker; modem; computer, moniter and mouse; scanner; fax machine; and drawing tablet.

The audio function allows participants at the transmission and receiving sites to interact—that is, to speak to and hear each other without any delay. Clearly, audio quality is a factor when considering the type of telephone transmission to use, and we will discuss this in Section IV. But even with high quality audio, you will want to set up the system in as noise-free an environment as possible.

The hard copy function allows both the transmitting and receiving sites to transmit and receive documents for printing on paper as "hard copy." In this way, teacher and students can exchange handouts, tests or homework during the class period.

A range of software and hardware choices will fulfill these three basic ADL functions. But since quality can vary considerably, you'll need to comparison shop and make a number of cost-benefit decisions.

Choosing a Software Program

The following are the four major distance learning software or operations programs commercially available for audiographics instructional delivery. All four have been used in educational settings, and pilot projects have demonstrated that each works. (See Appendix A, Glossary, for definitions of terms.)

1. TSN Systems' COMPUTER AIDED CONFERENCING

This audiographics system was specifically developed for educational applications. The basic system distributed by the TSN company is a software program and a Logitech mouse. Unlike programs that can use only prescribed accessories, TSN's software supports the use of varied equipment and numerous other programs. The result is a system with broad capability, limited only by the types and quality of components you add to it.

TSN recommends using an MS-DOS 286 computer with an EGA card and EGA monitor. This computer should have at least a 20 MB hard disk drive. The company offers a Sumagraphics drawing tablet as an option, if it is preferred over a mouse, for an additional cost.

As accessories are considered, the most functional component is probably a scanner. TSN recommends using Chinon's flatbed scanner, which copies in eight shades of gray and reduces or enlarges. However, the software will support other scanners. Color can be added during the slide/screen creation process. Text and three dimensional objects less than one inch high can be copied. For additional slide creation capability, you can use almost any video camera and a digitizer.

The computer aided conferencing software is programmed to operate a laser disk system at remote sites to call up teachers' preselected materials. When these materials have been shown, the system reverts to the last computer visual used by the teleteacher, so the teacher can continue a desired lesson sequence. The TSN software is compatible with the Pioneer 4200 laser disk player. The system also supports the use of word processing for text transmission and interactive annotating, as well as visual-creating programs such as PC Paintbrush.

For student-teacher voice exchange, almost any audio teleconferencing device or a sophisticated audio multi-microphone pick-up system will work. The TSN system can use almost any type of modem to allow nearly every combination of networking and phone line utilization. It will work with full duplex and voice/data modems (enabling it to adapt to one phone line or two) and will operate on high speed modems as well. (See "Data Modems and Voice/Data Modems," below.)

The major advantages of the TSN system are:

- It is the most economical;
- It will work with equipment that might already exist in the district;
- Almost any combination of technology can be assembled to create the customized system desired.

The major disadvantages of the TSN system are:

- If a voice/data modem is used to avoid the need for two telephone lines, voice quality suffers;

- If extensive and varied equipment is assembled, the technology might be difficult to use;

- Assembling a system from a variety of vendors can result in compatibility problems.

2. *The AT&T OVERVIEW Scanner and SCANWARE*

AT&T developed a PC-based communications system, the AT&T OVERVIEW scanner, with business needs in mind. However, this easy-to-use scanning device has practical application in education as well. The scanner "captures" (copies) images placed on its surface for viewing on a PC monitor. The system will transmit the captured images to other PCs at distant sites. Items such as pages of text, line drawings, engineering schematics, photographs and three dimensional objects up to nearly three inches high can be scanned and transmitted at the touch of a key.

The OVERVIEW scanner works as a partner to an MS-DOS PC 286 with a 20 MB hard disk drive. The two must be connected via an interface card. AT&T SCANWARE (software), together with PC Paintbrush, functions as the operating system. Devices used for control and annotation include an Audiographic Remote Controller (ARC), a computer keyboard, a mouse and/or a drawing tablet. The capabilities of the software are:

- Scanning options (in the picture mode). It has no color capability, but can use up to 16 shades of gray.
- Annotation capabilities. It will write on, draw on and point to.
- Display capability. It will display images to a live or remote group.
- Batch transmission. Batches of slides can be sent in advance.
- Other software support. It supports software for composing, editing, and coloring operations, including such programs as PC Paintbrush, Lotus, and CAD graphics.

When used with a high resolution EGA or VGA monitor, the scanner produces excellent screen quality or resolution.

The system's compatibility with available accessories is a mixed bag. It works well with several large screen monitors and projection systems, but to use either requires a video converter box. The SCANWARE operates most 24 pin or parallel printers, but demands a Kurta Series ONE or IS/ONE Tablet for drawing or annotation. For transmission, essentially any modem can be used, even those with speeds up to 19.2 kbps (if the phone line will allow it). A separate phone line is needed for data or visuals.

Visual transmission can be slick, fast, impressive and expensive, or deadly slow but more economical. Images can be sent to one site or many. Complete transmission of an image occurs after four passes by the scanner. Meanwhile, the viewer at the remote end watches something similar to a Polaroid photo developing. The most vital information is contained in the scanner's first pass, giving the viewer enough to recognize general content in three to 10 seconds. Subtler detail will arrive over a period of five to 45 seconds, as the scanner makes its next three passes.

Transmission time is determined by modem speed. Only a high speed transfer process would allow a teleteacher to continue speaking without waiting for complete visual transmission. So, unless modern phone-line technology and a very high speed modem are available and affordable, the teacher would need to prepare and transmit visuals prior to class.

The voice or audio must be transmitted over a second phone line, a standard dial-up line. AT&T ALLIANCE tele-conference bridging service and a Quorum Conference Phone are recommended by AT&T to allow the interactive voice communication. However, other audio devices will work.

The major advantages of the OVERVIEW Scanner are:

- Visuals can be conveniently created (copied)
- Extremely high image resolution
- The system is very user friendly
- Voice transmission is high quality

Major disadvantages of the OVERVIEW Scanner are:

- It's expensive where long distance rates are involved (two phone lines must be used)

- Initial system costs can be very high
- All scanner-created images are black and white; color must be added
- Slides or visuals need to be prepared and sent in advance of the lesson

3. *Educational Technology Consultants' AUDIOGRAPHIC TELE-CONFERENCING SYSTEM (AGS)*

Though the AGS system can be used in any corporate teaching or training environment, it was designed primarily for education. Distributed by a Canadian firm, the system is based on the premise that the instructor is teaching multiple groups of learners, and that visuals with annotation are being sent during the live instruction.

Because sophisticated slides or visuals take as long as two minutes to send to receiving sites, most system vendors recommend both preparing and sending them in advance. Visuals can be sent over any ADL system for down loading onto disks at the remote site, or disks containing the visuals can be hand-carried to the receiving sites. Either way, the visuals will then be ready to be "called-up" as needed during the lesson.

To shorten this process, most audiographics system developers have been switching to high speed modems carrying up to 9600 or even 19.2 kbps. However, since many rural phone lines will not handle modems faster than 1200 bps, AGS takes a different tack. Instead of transmitting the specific data bits that constitute a sophisticated visual, AGS transmits a list of commands. Each gives the remote site computer a neatly packaged group of things to do. By obeying these commands, the computer creates the desired visuals for student use. This concept makes it possible to send most system-created visuals over any phone line in four to eight seconds. Annotations go in less than one second.

The AGS system is made up of the following components: Audiotex View software, Audiotex MGE Page Creation software, Audiotex Receiving software, Microsoft Mouse and software, and an AGS-7 Package. This package contains four push-to-talk microphones with cables, a central control for

automatic audio/data switching, an audio amplifier, telephone circuitry, one phone and mini-adapter, one power cable, one 1200 bps multi-point modem, and a public address function.

In addition to this equipment and software, an MS-DOS computer with DOS operating software, and an EGA color monitor are essential but must be procured separately. (Note: AGS has just released an audiographics system for the Macintosh.) Optional items include a graphics tablet, a video camera and digitizer, a printer, and a large screen EGA monitor or a color LCD display projector. These optional pieces must be purchased from other vendors.

The instructor can have prepared a visual on his scr en for preview and then send the visual to all locations simultaneously. Finally, live annotation can be done by the teleteacher, or from any site by the students. Graphics are in color (64 colors with medium resolution). Since the system can operate in electronic blackboard mode, the instructor can create live materials during the lesson on a prepared tablet screen. Any background color can be used, with the work in white and black, or any of six colors.

The modem-phone line system is an Alternating-Single Line System. The voice utilizes the full band width or all of the frequency range of the phone line. Data, when sent, replaces the voice momentarily and uses the entire band width for maximum quality data transfer.

The major advantages of the AGS System are:

- Good voice quality
- Fast slide transfer
- Convenient interactive annotation
- Uses only one phone line
- Fairly economical to purchase

The major disadvantages of the AGS System are:

- Scanner-captured visuals/slides cannot be sent to remote sites at the same high speed as those created on the basic system
- Inconvenient factory service locations

- Possible importation delays and duty costs, since distributor is Canadian
- Inconvenience of using the push-to-talk microphone
- Possible clipping of voice when data is being transferred; the teleteacher must avoid talking when sending data

4. *Optel Communications, Inc.'s PC NETWORKING*

PC Networking enhances AT&T's ALLIANCE Teleconferencing Service (interactive audio) with visuals, displayed simultaneously on PC monitors at multiple sites. Rather sophisticated visual capabilities are allowed by a separate stylus device that provides simultaneous transmission of hand drawn images, written text, and notations superimposed on computer created graphics. The system permits the sharing of full color pictures produced by a video camera, VCR or videodisc player. A special modem allows the concurrent transmission of both voice and data over a single dial-up phone line.

The basic components of Optel's system are: conferencing software, graphics creating software, the company's Voice-Too modem, a stylus pen and a drawing tablet, and AT&T Truevision Capture Board. The system requires an MS-DOS (2.0 or higher) personal computer with 512 K RAM or more. A video camera, or any other equipment for visual imagery must be purchased separately. Each site will need an RGB color monitor. If you buy two monitors, one can be used for software (computer) created text and graphics and the second for color video pictures.
PC Networking enables four types of live graphics interactions to be seen at all sites. These are:

- Computer keyboard-created text
- Drawings and handwriting from the system's stylus and graphics tablet
- An electronic pointer (arrow), to call attention to details on the screen
- Graphics and text produced by software through screen capture

By using the Image Capture Board, colored pictures can be added to a file, integrating them with charts, sketches and other graphics, and text. Basic teleteacher controls are incor-

porated into the table, which also supports the annotation and drawing capabilities of the stylus.

The Voice-Too modem allows the use of a single phone line by using a portion of the frequency band width for data (visuals and text) while the major portion is used voice or audio transmission. The modem will support the networking of multiple sites through a device called a protocol system, which ensures that one modem at a time will transmit. However, the system will support the use of full duplex modems, and use of two phone lines.

The major advantages of the Optel system are:

- Tablet/stylus control is convenient and easy to use
- Permits easy image capture
- Has high resolution color video
- Uses one phone line

The major disadvantages of the Optel system are:

- Less than adequate voice quality
- Slower data transfer
- Higher costs

All four systems, TSN, AGS, AT&T and Optel are being used successfully in distance learning applications. Weighing their capability against costs, we suggest:

- Best buy: TSN or AGS
- Good buy: AT&T
- Fair buy: Optel

Once you decide which operating program (software) to use, some of the parameters for assessory choices are set, since each software system is compatible with specific types—or even brands—of equipment. TSN software allows the most leeway; AGS somewhat less; AT&T Scanware and Optel the least. So carefully determine procurement options, and buy accordingly.

Comparison of Audiographics Operating Systems

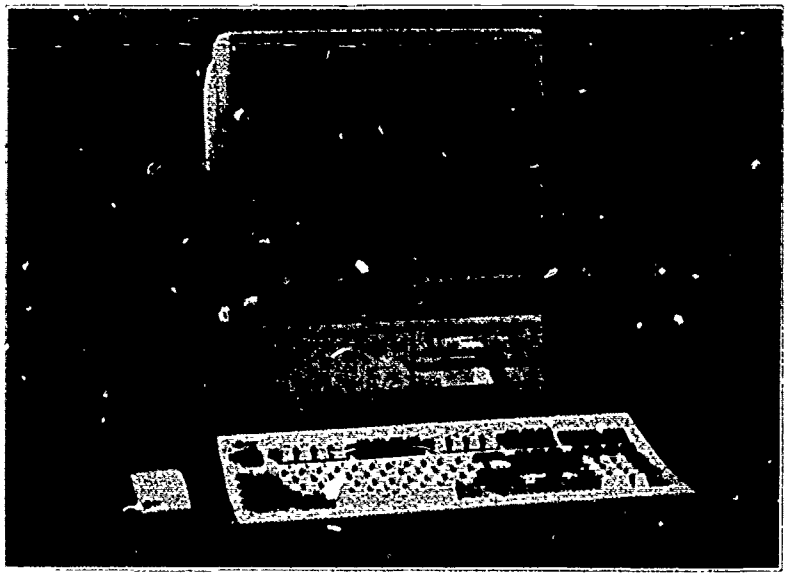
● = will support **all** major manufacturers' equipment
○ = will support **some** major manufacturers' equipment
Blank = will not support this type of device

		Operating Software System TSN	AT&T	AGS	Optel
Image Input	mouse	●	●	●	●
	drawing tablet	●	○	○	●
	scanner	●	○	●	○
	video (digitized)	●	●	●	●
	video (laser) disk	●	●		●
	image capture from other software	●	●	●	○
Live Chalkboard Capability	built-in visual modification	●		●	●
	visual enhancement from other software	●	●		
	visual enhancement from video disk	●			
Signal Transmission	Modem: voice/data-uses one phone line	●		●	●
	Modem: alternating-uses one phone line			●	
	Modem: full duplex-uses two phone lines	●	●	●	●
	Modem: high speed-over 2400 baud rate	●	●		●
	from one computer seriel port to another (no modem)	●		●	○
Graphics Display	EGA monitor	●	●	●	●
	VGA monitor	●	●	●	●

Specifications of Hardware for Visual/Graphics Creation

Computers

The basic electronic component of three of the software systems is the Central Processing Unit (CPU) or computer. While variations of some of the software will support Apple eight bit (IIe) format, and some will operate on a sixteen bit (IBM/compatible) 80867 (PC) format, using such slow processors could be frustrating to teleteachers and boring to students. As to operating memory, 128 K and 256 K are tolerated by two variations of two of the software systems, 20 MB hard disk is required by two others, but such capacity has critical limitations.



Our recommendation:

- Use an IBM/compatible 286 CPU (AT level) with 40 MB hard disk drive and keyboard with function and numeric keys (103 keys).

Computer Monitor/Viewer Displays

Some of the software programs allow the use of RGB color monitors, but level of image resolution (picture quality) is unsatisfactory for multi-student viewing. Most software vendors recommend EGA level, but their systems will support

VGA level.
With good reason, all of the ADL system vendors recommend colored monitors. Students are so used to color—from TV, video games, and computer monitors—that they are turned off by monochrome screens, especially black and white. More important, color helps contrast items on the screen, making them more distinct or easier to see. This is important when several students are viewing a single monitor.

When more than twelve students will need to see a screen, the normal sized computer monitor (13/14 inch color) becomes inadequate. For 13-20 students, use either a 19-22 inch screen or two smaller monitors. It is not advisable to use ADL for groups larger than 20, but if you do, consider using a projection unit and screen.

We recommend the following monitor and viewing equipment:

- EGA or VGA level 13/14" color computer monitor for groups of 12 and under
- EGA or VGA level 19-22" color monitor for groups of 13 and over
- An EGA or VGA card and port installed in computer.

Computer/Cursor Control Devices

Each operating system needs a keyboard. The big question is what supplemental device should be used—a mouse, a light pen, or a digitized tablet?

A light pen enables the teleteacher to draw on the monitor screen. She can see where her hand is relative to the images already on the screen—something not possible with a mouse or a drawing tablet. Physically, "drawing" upon an upright screen is awkward. But the biggest problem with a light pen is the risk of placing static electricity on the screen that may "trash" the drawing, or even the computer!

The drawing tablet is fairly easy to use and has definite advantages for drawing graphics and illustrations. Visuals can be photocopied, registered on the drawing tablet to ensure proper monitor fit, and then traced. The tablet makes everyone

an artist. However, it is more expensive than a pen or a mouse.
We recommend that schools:

- Buy a tablet, budget allowing

If not, buy a mouse. Either way, be sure that the brand of tablet or mouse purchased is supported by the operations software.

Image Capture Devices

The four systems support two types of image capturing devices: video cameras (coupled with digitizers) and scanners.

A video camera is more economical and also is more versatile, since, it is not locked down and has a lens that can be focused for distance. However, video cameras are much less convenient than scanners, since they must be set up for nearly every shot.

The scanner is always ready to go. Its lens is fixed focus, and on one model, the lighting is always set. The teleteacher merely has to place the image on the scanner stand and push the command key. The scanner's major disadvantage is that the object to be scanned must be no bigger than the stand (generally 8 1/2 X 11 inches) and no taller than one to three inches, depending upon the brand of scanner. Since scanners are relatively expensive, you may want to buy one for teleteachers only, not one for every receiving site.

We recommend that schools:

- Procure a scanner first, a camera and digitizer second

Be very careful that your software system will support your chosen scanner.

Specifications for Audio Hardware

The Sound System

Obtaining adequate sound quality is another challenge. If a

school system chooses to use the AGS delivery system, the basic sound equipment is purchased as part of the package. Since the modem alternates sound and data, only one phone line is needed. The total frequency band width is used, and the sound is as good as the modem and the phone line together will allow. Four push-to-talk microphones and a company-manufactured device called an AGS-7p are the remaining components. The microphones and the AGS-7p mixing-transmitting unit are also high quality.

With the Overview Scanner system, AT&T recommends using an AT&T Quorum Conference Phone and a Quorum Teleconferencing Bridge or Alliance Teleconferencing. Since two phone lines are needed for this system, alternative sound systems can be considered. A school system can use good generic equipment with good results.

Using a voice/data modem limits sound quality. The frequencies dedicated to transmit data are from a part of the band width that subtracts severely from those frequencies needed to transmit higher pitched voices. Thus, the quality of a teleteacher's voice may suffer. TSN and Optel systems both support the use of a voice/data modem, but one shouldabe considered only when costs are an important factor.

The TSN and Optel systems will support any sound pick-up technology that feeds a phone line. TSN sells an easy to use device called Harvard Elite. It works well with a voice/data modem, but is very effective when a separate phone line is used for audio.

Hard Copy Hardware

Fax Machines vs. Computer Printers

Teleteachers and students must be able to exchange hard copy, or printed materials, such as tests and assignments—which may vary from written reports to mechanical drawings, from grammar drills to architectural renderings. There are two ways to send hard copy over phone lines: 1) by "down-loading" from the teacher's computer at the origination site to printers at the student receiving sites; and 2) by faxing materials from a machine at the teacher site to fax machines where the students are. In both instances the material is changed to

and transmitted as data, then translated back into visual symbols as it is printed upon paper.
The advantage of using the computer-to-printer method is that the cost of a printer is about half that of a fax. Faxing, however, is faster, involves lower transmission costs if a long distance phone line is used, and results in better quality graphic illustrations. So most distance learning projects are procuring fax machines, though some are using printers as well.

Transmission Hardware

Data Modems and Voice/Data Modems

Earlier, we discussed the types of modems supported by and compatible with specific software operating systems. Now let us offer some advice for choosing a modem:

- Use the fastest modem available and affordable that is supported by both your software operating system and your telephone line baud capacity.
- Use two phone lines and two half-duplex modems per site when long distance rates are not involved.
- Use an alternating modem when excessive long distance rates are a factor.
- Use coherent voice/data or a Voice-Too modem when phone rates are excessive and telephone line technology is modern.

IV. Procuring And Installing An Audiographics System

Procuring and installing an audiographics program involves several key phases: preliminary planning; installing the proper telephone lines; procuring, installing, and testing equipment; designing a maintenance plan for your system; and creating an effective learning environment. Here we offer some hints for success each step of the way.

Preliminary Planning

Fortunately, you are not without resources when you attempt to bring an ADL program to your district. Information about ADL can be obtained from universities, consortia, ADL school sites (See Appendix C), and local and state boards of education, and by attending conferences.

Installing the Proper Telephone Lines

The installation of functional audiographics telephone lines may be a simple process or, depending on your circumstances, an extremely tricky one. Though all of the existing ADL systems use software and equipment that require regular telephone circuits with typical dial-up or standard phone-line characteristics, there are multiple options for "transporting" audio and graphics/data over telephone lines.

Factors that complicate telephone line installations are: the number of sites to be networked or connected; the hours per day the phone line will be used; the distance between sites and the route of the lines; the number of phone companies involved; and the costs of line service, or tariffs, as phone companies call them.

If only two schools are to be networked, and long distance rates are not involved, simply install a standard telephone line with a regular 232 phone jack or connector. If three schools are to be networked, then "three-way calling" should be considered. This service, offered by most phone companies, is usually installed at the originating site to give the teleteacher control of the connecting process.

If more than three sites will be networked simultaneously, it is possible in some instances to "daisy-chain" them. To set up a daisy chain, the first site calls a second, the second puts the call on hold and calls a third, the third puts the call on hold

and calls a fourth, and so on. This process can be a way of sometimes avoiding long distance rates. If calling is local it might be wise to install and use two phone lines between each of the sites, one for voice and one for data. The quality of the signal delivery would be enhanced and the cost is minimal.

Another way of networking many sites is to have the phone company set up a private line dedicated solely to the use of the system. A dedicated line will add costs, but when long distance rates come into play, there probably will be a cost cross-over point (approximately one hour of use per day in most instances) when it will be cheaper to use a "dedicated" or private line.

As larger networks are formed, "bridging" becomes necessary. A bridge is a device that allows multiple telephone lines to be connected together. It can enable up to 60 sites to be connected at one time, and its special circuitry ensures that all the lines have the same strength of outgoing volume. Bridging is a service provided by the phone company, though a bridge can be installed as part of the originating equipment and be locally or privately owned. For small networks it is usually better to purchase bridging service from the phone company.

In this phase of your planning, one point cannot be emphasized enough: *know the phone line transmission capacities before you pay for and implement any of your ADL system*! Otherwise, the surprises may be unpleasant. Recently, in a remote part of the West, a local school district collaborative (consisting of four sites as much as 120 miles apart) had a dedicated phone line installed, then found that the newly-procured audiographics equipment would not function properly on the line. There were voltage-loss problems due to long transmission distances. Inadequate phone line equipment also led to echo or feedback problems. In fact, when troubleshooters investigated, they found telephone cable strung along fence posts or on the ground while crossing some of the desolate terrain—clearly a situation that would lead to line loss and compromised transmission. Several months passed before these problems were resolved, primarily because the three local telephone companies involved had to iron out their own disputes over jurisdiction and responsibility.

In another project, a school district discovered that phone lines going to a community 55 miles to the south traveled over 500 miles through three other states. Not only would there be problems with multiple phone companies and line quality, but long-distance rates and interstate regulations would make the expense astronomical. Needless to say, the idea of an audiographics delivery system was dropped.

Work with the telephone company when planning for the use of a dedicated or private line. They are the experts on phone lines. They can help you determine what type of phone line transport is the most practical. As they install your telephone line, it is important for them to know how you are going to use it. Give them a list and description of the equipment you plan to use. They will need to know the specifications of the modem, especially if it is a voice/data or multiplexing type.

Procuring, Installing, and Testing Equipment

Once you decide which operating system and supporting technologies to buy, work closely with your operating system vendor. Make sure that each component will be supported by the operating software. As you purchase accessories, tell the vendor (of each and every device) how you plan to use the equipment. Get the vendor's assurance that what you're buying is compatible with the other equipment you plan to use. Make sure it will perform according to your specifications. And if it turns out that it doesn't, make sure you can return it at full value.

More than that, invite the vendor to install what you purchase. If you are buying three or four pieces, the vendor may be willing to handle installation without cost, unless long distance travel is a problem.

Pay attention to the little things. When you purchase equipment, make sure you have any needed cords, adapters, and power supplies. Buy extension and extra-long cords when necessary. Surge suppressors should be used on both electrical and telephone lines, and all equipment should be properly grounded. Dust covers are desirable for some items.

It is important to create a functional work station for the teleteacher. A large, solid table with an ample work surface is a good beginning. Be sure there is room for the computer,

monitor, scanner, drawing tab[illegible]nd devices, fax machine and printer. An adjustable [illegible] critical, both for the teacher's comfort and for easy access to teaching materials and technical tools. (Some office and school furnishing companies sell ready-made work stations.) At the receiving sites, a large table can be used by small groups of students. Larger groups will want a tall, solid monitor stand for ease of viewing.

When you turn on your newly acquired system, assured that everything is working, leave it on for a day or so. If a piece of equipment has a weak component, that component will usually fail in the first few hours—and you will want to discover potential problems as soon as possible. Keep on hand a telephone list of all those you may need to call for technical assistance.

Developing a Maintenance Plan

Evaluation studies of existing ADL systems report the technology to be very reliable. Only once or twice during a school year, generally, do problems develop. However, teachers and students quickly become disenchanted with technology that fails them. So you'll want to avoid problems if possible and quickly take care of any that develop. An ADL system owner should adopt proper maintenance procedures. Here are some suggestions that may help:

- Establish a maintenance budget. As stated earlier, the amount needed annually for repairs approximates four per cent of the original cost of the equipment. And as you plan for future replacement, consider that most ADL technology should be amortized over a period of five years.

- Train both teleteachers and learning facilitators thoroughly on the proper care and use of all system components, both software and hardware. (Human error, especially improper use, is the greatest cause of electronic equipment failures.)

  Assign one specific individual in the school building to be responsible for the care and

maintenance of the system. If there is a media specialist available for this task, train and use him/her.

If the project networks numerous schools, train a troubleshooter who can move about the district, county, or region making repairs.

- Develop partnerships that can provide maintenance support. Utility companies, universities, and local electronics businesses often will provide this kind of help.

- Work out maintenance arrangements with vendors if possible at economical rates. Seek vendor agreements to provide rapid repair service—and get all agreements in writing. Have a list of vendor phone numbers handy.

- Obtain as many backup items as you can afford. One school district with several sites has found it worthwhile to have one complete backup system. At very least, it is critical to make duplicate copies of all software.

- Place equipment solidly and safely on appropriate tables, desks, consoles, and/or carts.

- Purchase dust covers for computers, fax machines, printers, etc., and use them regularly.

- Use surge suppressors on electronic equipment to prevent electrical charge damage. They are available for telephone lines as well as electrical lines. (Systems have been damaged by lightning.)

Avoid static electricity by steering clear of materials that create it, such as nylon carpet.

Creating an Effective Learning Environment

For your ADL system to be a valuable instruction tool, you must create an effective learning environment. The room should be:

Quiet and acoustically sound. The weakest component of most ADL systems is the audio component. Unidirectional voice pick-up by speaker phones, or even by a high quality microphone and sound system is inadequate. Multi push-to-talk mikes do better, but are not problem-free. If a voice/data modem is used, voice quality is further compromised. So there's much to be gained by choosing a room in a quiet part of the building and adding acoustical tile, carpet, and drapes.

Big enough. The room should be no smaller than 30 square feet per learner; a minimum of 300 square feet is recommended. The equipment and the unusual and varied student activities demand this much space.

Near the media center. Such a location makes it easy to get critical media access and support.

Equipped with dimmer switches and drapes. You will need to control light that may cause reflection or dim the images on a monitor screen. Also, heat from direct sunlight can cause equipment problems as well as make students uncomfortable.

V. Organizing The Audiographics Program

As you are procuring and installing equipment, you will need to be laying the groundwork for implementation. Successful implementation of an audiographic program requires forming partnerships; securing sufficient financial support; managing potential scheduling conflicts; selecting teleteachers; providing appropriate training, support and compensation for teleteachers; ensuring that quality instruction is being transmitted to the distant site; managing staffing at the distant site; and conducting ongoing evaluation.

1. Forming Partnerships

For a distance learning program to succeed, many different groups need to work together as partners. These include members of the education community—school district personnel, county and state Offices of Education staff—as well as people in community businesses and organizations. All groups should be continuously involved in planning. This is particularly important for policy makers, superintendents, principals, and teachers, all of whom must develop a consensus about program goals, course development, kinds of external assistance needed, and financial resources available to support the program.

- Develop "ownership" of ADL among principals and other administrators at the originating and receiving school sites by involving them in decision making from the outset.

- Build teacher buy-in by involving teachers at all ADL sites from the initial planning stages right through implementation. Establish a mechanism for keeping all faculty informed about how the program is progressing. This could mean sending out weekly bulletins or, in a very small district, may be as simple as talking regularly over lunch.

- Plan and implement strategies that will inform students and parents about audiographics distance learning. Build excitement about the program before it begins. Survey parents, for example, and get their approval. Later, hold a special evening session where students and teachers demonstrate to parents how ADL actually works. Invite parents to come to class

whene r they'd like, and keep them informed of changes such as the addition of a fax machine and why that's an improvement. Continuing such promotional efforts will help foster enrollment in ADL courses.

- Inform local businesses and community organizations about future ADL plans. Obtain their support and involve them in planning.

- Form an ADL consortium with interested groups and develop a structured organization. This may be a formal organization responsible for helping administer the program, or it may be informal and strictly advisory.

2. *Obtaining Funding*

Plan to support your ADL program with ongoing monies. Because a system costs as little as $6,000 per site to procure and install and is economical to maintain, you probably won't need monies from outside of the district or county. (See Appendix D for more detailed cost estimates) If outside money is needed, it is best to raise it from within the appropriate support group, the ADL partnership. Though it may be worthwhile to seek grant money for start-up equipment costs, remember a successful ADL program will outlive the grant.

Budget for: 1) procuring and installing equipment; 2) system maintenance; and 3) the training and compensation of personnel.

3. *Selecting and Scheduling Courses*

Carefully examine your school's curriculum and determine what courses need to be added to fulfill graduation requirements or provide a broader array of offerings to students. Then you'll need to:

- Determine likely student interest in these offerings. (Something to think about: essentially every type of course has been successfully delivered via ADL, including art and music—where quality visual resolution, color, and sound are important—and biology, technology, and chemistry, where labs are critical.)

- Determine whether or not you can cost-effectively staff the receiving site with an adult who can effectively facilitate learning. Some schools assign a teacher; others a teaching assistant or parent volunteer. (See point 6 below.)

- Figure out optimal times for transmitting courses so that they don't disrupt master schedules in either the sending or receiving school. ADL course scheduling should be done at the same time as scheduling for all yearly or semester courses.

- Prepare for growth and fluctuation of ADL enrollment from year to year. Be ready to hire extra staff, move to a larger room or procure additional equipment to accommodate additional ADL students.

- Give teleteachers the opportunity to teach their ADL course for at least a second year. Once they have developed a semester's or a year's worth of slides, teleteaching materials, and expertise, they can enjoy refining their course. It also provides the school's ADL program with continuity and potential ADL master teachers.

4. *Selecting Teleteachers*

While good scheduling and solid content are clearly essential for ADL courses, the most critical factor for success is the quality of teaching. You will, of course, give new teleteachers special training in use of the equipment and ways to develop materials and visual aids for students at distant sites. But first you must carefully select the best teleteaching candidates. The ideal teleteacher is not only qualified to teach the subject area, but also has:

__ a voice suited to audio-transmissions
__ the self-confidence to try new things
__ stage presence
__ clear enunciation and an understandable speaking pace
__ a flair for the dramatic
__ an artistic bent
__ creativity

- persistence
- a sense of comfort with technology
- good organizational skills
- a willingness to adapt teaching techniques to technology

Not all classroom teachers would make good teleteachers; but a good teleteacher is a good teacher. One school administrator remembers interviewing candidates for two foreign language positions, both of which included teleteaching. The teachers he hired turned out to be two of the best he's ever seen. His explanation? The only teachers interested were those willing to be innovative and flexible in their teaching methods—qualities he feels are hallmarks of gifted teachers.

5. *Developing and Implementing an Effective Training Program for Teleteachers*

Successful teleteachers repeatedly comment on the importance of training. One teacher who had no prior experience with computers said that her school helped her get used to teaching with technology by placing a personal computer in her room for a semester. Gradually, she learned how to use it and incorporate its capabilities into her lessons. When later asked to teleteach, she was not intimidated. Even those with substantial computer and programming backgrounds find the training invaluable. Assuming that teachers will figure it out on their own can ruin a school's teleteaching program, warned one. The district or school should provide thorough training, and compensate teachers for the investment of their time.

Training must cover two strands: how to use the equipment, and how to adapt a teacher's usual techniques to the distance learning medium. Here is some advice on finding good training resources:

- Determine whether or not the operating system (software) vendor offers a training program for teleteachers and remote site learning facilitators (adults at the receiving site). The program may meet your needs at a cost you can afford. Consider that ADL training is offered by all four vendors discussed earlier. AT&T, distributor of both its own OVERVIEW Scanner and the Optel system, teaches courses on their own

premises at various locations around the country. (There is a registration fee.) AGS and TSN will come to you with training. (The fee here is negotiable.)

- Training is sometimes sponsored by the colleges, universities and consortia that work with distance learning Determine whether this is happening in your area. Also look into conferences that focus on audiographics.

- Determine whether there are other districts in your area that wish to train their teachers in audiographics. Design a plan with these districts and pool your resources.

- Send teleteachers to other schools where there are successful ADL programs to observe teleteaching models.

- Look into national conferences that focus on audiographics and related topics. Send the teleteachers themselves—they'll return excited and ready to implement what they've learned.

- Provide the teleteachers and learning facilitators with a "help" hot line, normally available from the vendor.

- Allocate time for teachers to become comfortable with the new system and assignment. Let them practice with the technology for 20-30 hours.

- Allocate time (summer or extra preparation period with compensation) for the teleteacher to prepare materials and visual aids for audiographics transmission.

- Make sure that teleteachers and learning facilitators devise classroom management techniques that engage students at all sites, particularly the receiving site. Teachers must learn to compensate for the loss of body language by using new skills such as active listening. They must be able to discern different voice tones; identify inflections and volume that communicate feelings and interest; differentiate individuals by voice; and identify activities by sound. (Ideas for ADL

classroom management and instructional strategies may be sought from experienced ADL users in other districts and from Dennis Wydra at Mansfield University—see Appendix C).

- Establish a teleteaching mentorship program.

6. Selecting and Training Learning Facilitators

The adult at the distance location is generally responsible for operating the receiving equipment, monitoring student behavior, evaluating homework, supervising testing, and assisting with training. He or she might also perform other activities as assigned by the teleteacher.

A learning facilitator does not have to be a certified teacher or have training in the subject area being taught. He should, however, be able to manage and work with small groups of students. Many teleteachers say that the success of their class depends partly on the ability of the facilitator to keep students on task. They must be sure that students are paying attention, and that they are applying themselves. Many teleteachers use a grading system where the learning facilitator assigns a portion of the student's class grade—this recognizes student performance and cooperation in areas that the teleteacher may not be best able to judge.

- Provide the learning facilitators with 3-4 days training on how to operate and maintain the delivery system.

- Define and communicate the duties and responsibilities of the learning facilitator and his relationship to the teleteacher. If this is not done the learning facilitator may assume a role that is counterproductive.

7. Designing an Evaluation Plan

Teleteachers and school administrators should be aware of project effectiveness. These programs will help.

- Monitoring student progress at receiving sites.

- Conducting regular conferences with teleteachers and learning facilitators to be apprised of how the system is

functioning and what corrective actions, if any, need to be taken.

- Conducting year-end evaluation activity, including an examination of student outcomes such as attendance, attitudes about the system, grades and other achievement indicators.

VI. Using The ADL System To Facilitate Learning

Only imagination limits the ways ADL can be used to enhance learning. Here we look at three general instructional methods: 1) teacher-led instruction using teacher-generated materials; 2) student use of the system to interact with the teacher and with other students; and 3) student use of the system's technology for individualized learning.

Teacher-Led Instruction

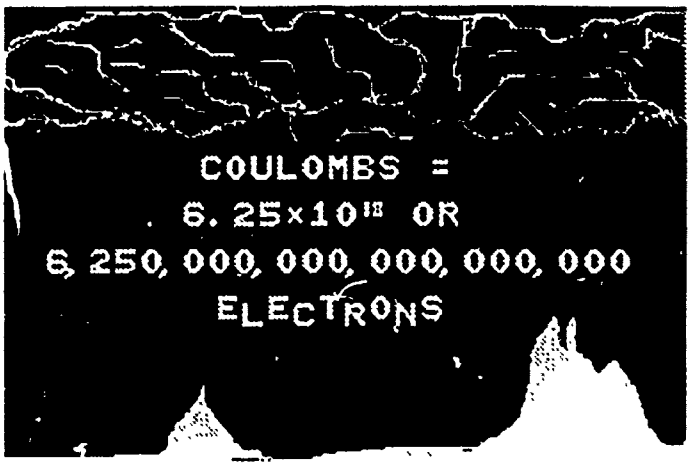
Teachers so inclined can teach in very traditional ways with ADL. The system allows them to explain things with the help of the electronic chalkboard, discuss material being presented, make assignments and correct them, and give tests to see what students have learned. But what makes the system a success—despite the inability of students and teacher to see each other—is the way it allows teachers to convey a lesson with highly powerful visuals. So teleteachers have every incentive to unleash their creativity in preparing these visuals.

The teleteacher can develop visuals live while students are observing. Or she can produce them in advance, possibly adding such things as underlining or annotations during class. Most teachers report that preparing visuals in advance makes the lessons more effective.

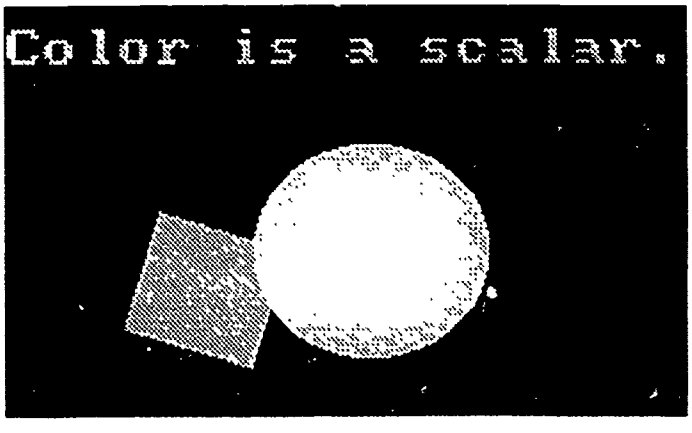
Using the system to create visuals does require some understanding of graphics applications. But teachers with one or two years' experience with ADL say that the job is less difficult than it is time consuming. To save time, teachers can prepare some of their own slides and purchase others from commercial sources. One software vendor has also started a lending library of audiographics slides—which districts can join by donating copies of its own slides for circulation. Another option—again limited only by creativity—is to assign students to create slides as part of their course work.

Creating and Using Slides.

No more information should be placed on a slide than necessary. Use as few words as possible, unless text is what is being illustrated. Make sure all letters and symbols are large enough to be read at student-viewing distance. As you look at the following examples, imagine them to be the size of a computer screen.



Color not only makes a slide more attractive, but provides contrast for readability. As you compose and lay out your visuals, remember that computer screens use a horizontal format (a ratio of 2 high X 3 wide), not a vertical one like a book or sheet of composition paper!

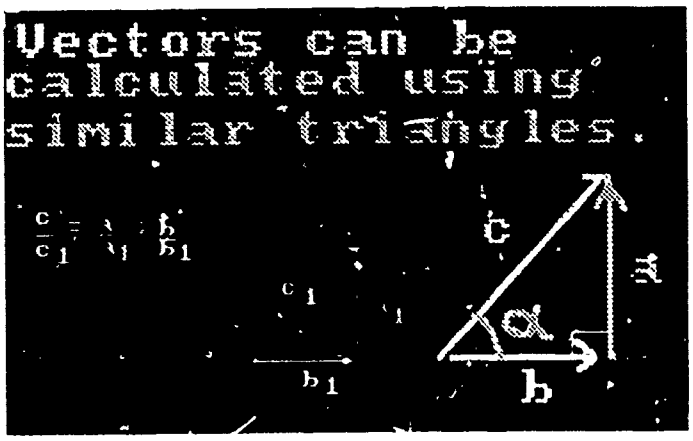


As teachers strive to make visuals interesting, ADL allows a major attention-grabbing feature: motion. Slides—whether film or computer—are usually static. But the ADL software programs support rapid changes of image arrangement that

can result in Disney-like animation on the screen. One biology teacher, for example, uses such animation to illustrate how wind and weather affect the artistry of a spider spinning its web. He also moves the jaw parts of this grasshopper so that it chews just like a real one.

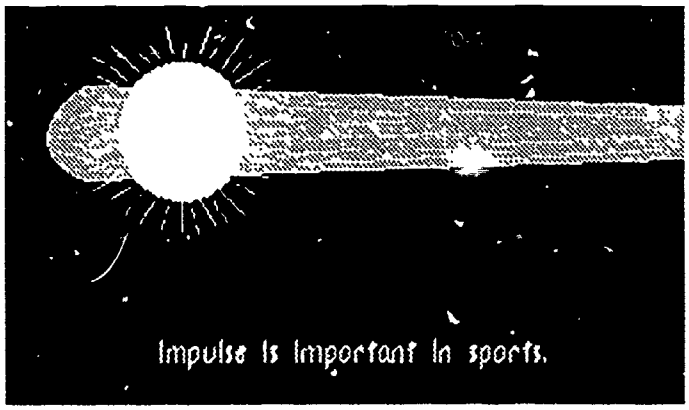
How is it done? The grasshopper was copied from a picture by image capture using a video camera and digitizer. (A scanner could have been used.) Then the insect's image was altered as needed in five additional slides. The teacher used the first slide of the complete insect as an introduction. He altered a second one to show an enlargement of the insect's face. (He kept this image static so that the teacher could discuss the basic mouth structure.) Slides three through six were like slide two, except that the jaw positions were different in each. When the teacher programmed the computer to change the slides, in a looping fashion, every tenth of a second, the insect came to life. (A computer software program known as Animator can also create such an effect automatically.)

Slides can be prepared using a mouse, drawing tablet, or keyboard. Some of the operations software supports the creation of line-type graphics such as might be needed to teach physics or geometry.



It the software does not support line-type graphics, they can probably be drawn with an adjunct software program. In most instances, a mouse would be the most convenient tool for drawing graphics on the screen. Its weakness is that it sometimes lacks precision. In such situations, the teleteacher can use a keyboard, which can "draw" from pixel to pixel (one light dot on the monitor screen to the next).

A drawing tablet is similar to the mouse in its capability and ease of use for making line graphics. When annotating a visual or slide, text can be added by using the keyboard or—to save time—the drawing tablet.



Freehand illustration is best accomplished with the drawing tablet. It does takes practice, but even without an artistic bent, teachers can draw well by placing a photocopy of any illustration on the drawing tablet and tracing over the photocopy.

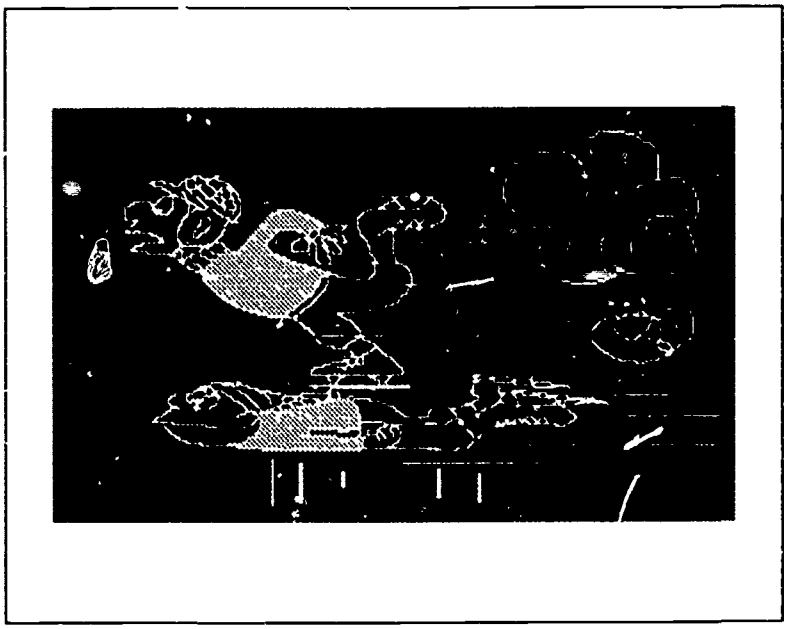
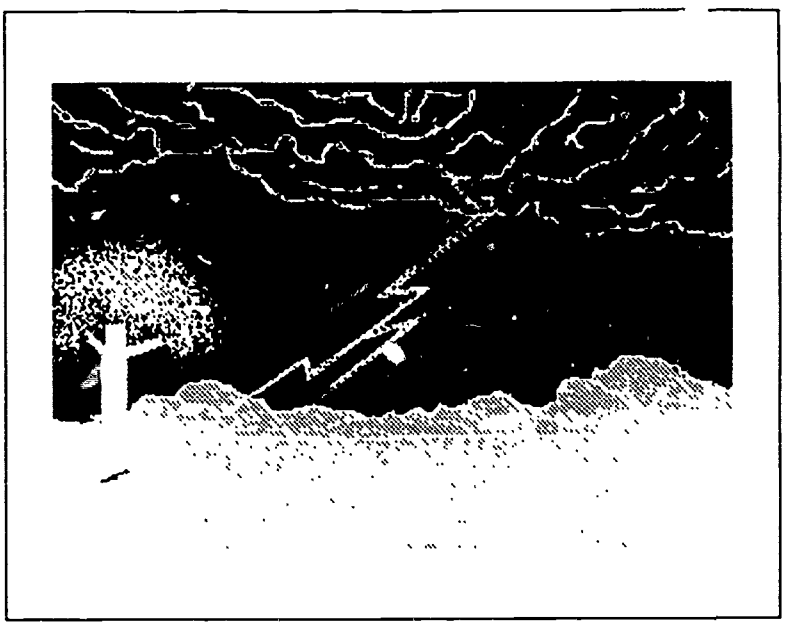
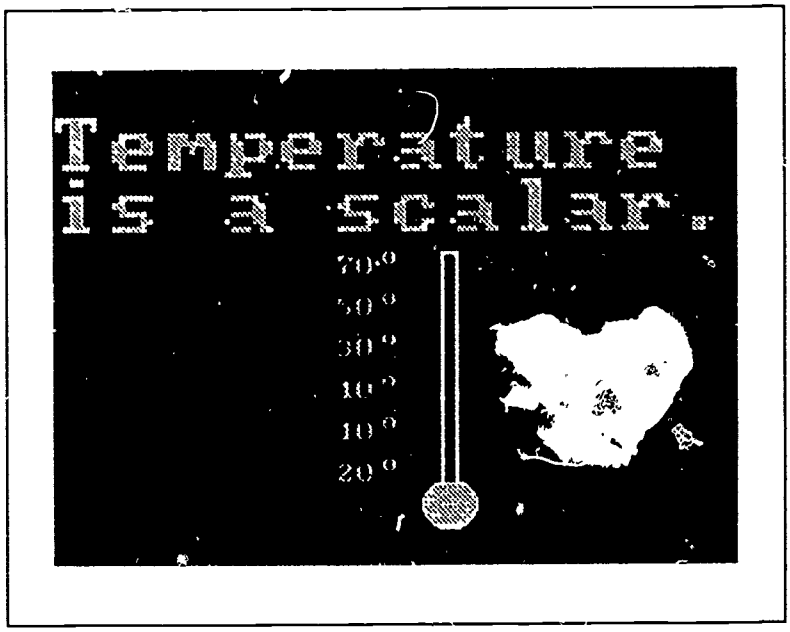


Image capturing allows a teacher to use most anything in nature or the environment— flora, fauna (animate or inanimate), pictures, illustrations, maps, or charts. For example:



Shading or filling areas with gray or colors is easily done with the color-add process supported by a couple of the operating systems, or by using an adjunct software program such as PC

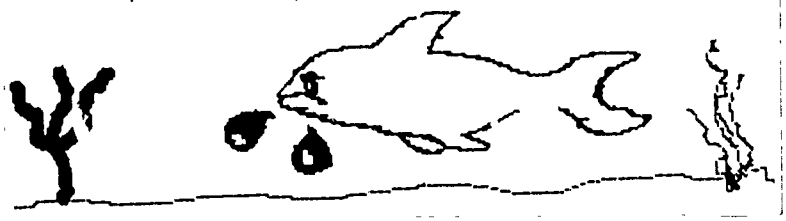
Paintbrush. Doing this during the lesson can call attention to certain shapes or images, helping to maintain student interest.



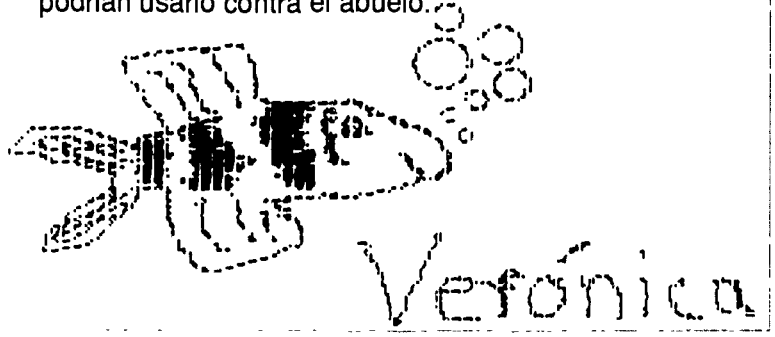
Student Use of the System

When students produce slides as part of their assigned work, they indeed lighten the teacher's load, but—more important—they deepen their own learning. In order to develop slides for an English course, for example, they may need to analyze an idea in literature or think through a grammar concept. In math, they might illustrate a creative solution to a problem. Students in one advanced Spanish class worked in groups to produce an extended, illustrated story in Spanish on slides, including these three:

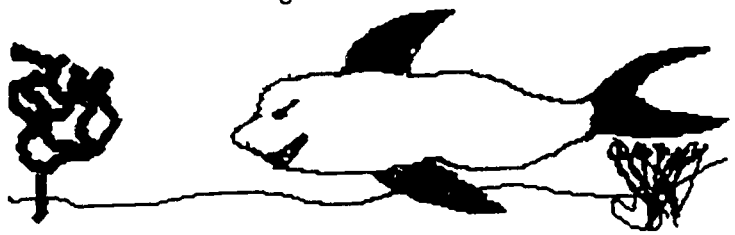
Una vez vivia un pez llamado Frederico en la ciudad de escolla. Estaba muy bien conocido y todos lo amaban. No tuvo un enemigo en el mar.
Un dia Frederico estuvo triste porque su mejor amigo Veronica habia ido a un peublo diferente. El alcade del pueblo de Codville le preguntó si podria enseñar una clase de nadar en su peublo. Ya que era un pez tal simpático, lo aceptó.



Fredrico Supo que tuvo que haser algo rapidamente porque abuelo le dio a Fredrico dos dias para salir del escollo de la Ciudad de Conche. Él tuvo que ayudar a su amigo.
Fredrico recorda que Veronica era un buen madadora. Él dijo que habria una manera en que podrian usarlo contra el abuelo.



Frederico sentia triste porque echaba de menos a su buena amiga Verónica. Nadó por el coral externo del puebie como si fuera el fin del mar.
El abuelo Fishless era el pez más taca ño de la escuela Tuvo los ojos verdes tacaños y aletas violetas. Su padre lo educó a conquistar y gobernar la ciudad de escolla y algun dia ser rey del mar.
Fredrico se haria pronto rey de la ciudad y el abuelo Fishles nunca se largaba con él.



For maximum benefit, students should explain their concepts live to other students using the system much as they might use a chalkboard—typing documentation, underlining or drawing with the tablet, or using the pointer—with all of these activities appearing on the screen of each of the sites.

Personally using the ADL system gives students a chance to further develop computer and artistic skills. They also gain a deeper understanding of the functions and capabilities of the

system and shed any fears of technology. More than that, through interactive use of the system, students in the originating and receiving locations feel more like a single, united class.

Rather than let the equipment sit idle at the receiving sites when not being used by the teleteacher, allow students to use it. ADL equipment can help small groups of students, or individual students develop skills or improve understandings in a number of ways. Students can simply create a visual or do word processing. Or they can use the computer, modem and printer to access information on almost any subject from such sources as GTE. When a laser disk player is added to ADL system, students can access a wealth of professionally visualized information.

Many excelient tutorial programs are available on almost every subject. And increasingly available are Intelligent Computer Assisted Instruction (ICAI) programs that allow students to carry on a dialogue with the system, rather than just responding to it. ICAI supports problem solving activities, thus helping develop higher order thinking skills.

VII. Multi-Media DL: The Way Of The Future

Educational technologists continue to look for better ways to deliver distance learning. One new trend taking hold now is "multi-media distance learning," or hybrid DL projects that combine either whole systems or components from differing systems. For example, one national distributor of tele-courses was using one-way TV with a telephone return, but decided to add the capability of fax machines and interactive computer graphics—essentially merging one-way TV with ADL (telephone line) technology. Students once able to ask the teacher a few questions now have enormously expanded interaction with their teacher. Similarly, a number of two-way TV projects have added fax and computer data/information delivery to their interactive TV networks.

Pacific TELESIS (Pacific Bell Telephone Company) predicts that "video walls" soon will replace the video telephone, which itself was just recently introduced to the consumer market. Video walls allow teleteachers to see their remote site students not only live, but in real-life size. If teaching two remote classes, teachers would have two "walls," and so on. Exciting, yes. But it can only happen when most copper wire telephone lines have been replaced with fiber optics—a change that will take a few years.

Meanwhile, CODECs (coder-decoders), or devices that compact video or TV signals for transmission over phone lines—either copper or fiber—continue to be improved. And the decreasing cost of CODECs has already brought them within the budgets of many educational telecommunications projects. Because this new CODEC technology can compress a video signal and send it over almost any telephone line, educational agencies are now exploring the possibility of adding two-way video (sent across phone lines) to audiographics delivery. Though several years away from general application, two-way CODEC video plus ADL is probably the way of the future.

Appendix A: Glossary

Bridge: a device that allows multiple phone lines to be connected for concurrent use by multiple callers. Some bridges support as many as 60 sites. Each is composed of circuitry that makes sure all of the lines have the same strength of outgoing volume.

Coaxial cable: an insulated wire cable that is used primarily for transmission of telephone, radio, and television signals.

Computer Specifications:

286 or 386 (Computer micro-processors): A computer with a 286 or 386 micro-processor which is the central processing unit of the computer. The numbers indicate the speed at which a computer will process information. 286 and 386 micro-processors will operate the ADL software efficiently.

Hard disk drive: a rigid platter or disk built into a computer used for data storage with greater storage capacity than a floppy disk.

MB (Megabytes): In the ADL context, MB is a reference to the capacity of a (hard) disk to store information. "20 MB" indicates that the disk has a capacity to store 20,000,000 bytes of information. "40 MB" is recommended by some ADL stoftware vendors.

MS-DOS (Computer): A computer that uses MS-DOS operating software and is said to be IBM COMPATIBLE.

RAM: (Random access memory): Memory storage within the computer that temporarily holds programs or data while the computer is operating. It can be written into or read from very quickly. In an ADL context, a computer with a RAM of at least 512 K (512,000) memory is needed. A capacity of 640 K, or more, is desirable.

Drawing tablet: a device or tablet that when drawn or written upon (similar to a chalkboard), converts or digitizes the material into data and sends it to the computer in much the same fashion as a mouse.

EGA card: an electronic card that fits in a computer and enables the computer to utilize and EGA monitor.

Fiber optics: a cable that is made with strands of fiberglass. Instead of utilizing a sound or electronic signal, it supports beams or bursts of light with varied intensity. A device at each end of the cable translates the signal from electronic to light and back again.

Hard copy: a permanent, printed paper copy (document) of information as compared with the intangible display of information on a computer monitor or TV screen.

Image capture: an image of any type (animate or inanimate) is videographed ("filmed") with a video camera. A device known as a digitizer looks at one frame of video and turns that picture or image from an electronic to a digital state, then sends it to the computer for processing. The computer places that data (image), on a disk—now referred to as a "slide"—and the image is said to have been "captured."

Interface card: an electronic card that fits in a computer and enables devices that work differently to interact or become compatible with each other.

Laser disk: a metal disk containing video programs that can be played back and viewed much as if they were on a video tape. However, any single event, picture, or piece of information can be accessed/viewed instantly. A disk has huge storage capacity.

Laser disk player: a device that plays the laser disk and can be controlled by a computer, making an important component of ADL.

LCD projection panel: A device that has a transparent or see-through screen called a "liquid crystal display" or LCD. The LCD panel is used on the top of an overhead projector. It is connected to a PC in the same fashion as a computer monitor. When computer images appear on an LCD (transparent screen), these images function as transparencies and are enlarged and projected on a screen by the overhead.

Microwave: a signal of UHF sound waves. A series of transmitters and receivers (microwave-relay) is needed to handle communications between widely separated sites.

Modem(s):

Alternating single-line modem: A modem that uses a single phone line, but can send two-way voice and two-way data (graphics) making both signals interactive. It does this by sending each upon command (by pushing/releasing a button), thus alternating between voice and data.

Full-duplex modem: a type of modem that can transmit data in both directions simultaneously over telephone lines.

Half-duplex modem: a type of modem that can transmit data in both directions over telephone lines, but in only one direction at a time.

High speed modem (9600 bps/19.2K): a modem that transmits data or information over telephone lines at the rate of 19,200 bites per second (bps). Slower modems transmit at 300 bps, 1200 bps, and 2400 bps.

Monitor/s (EGA and VGA): In an ADL context there are fewer suitable color monitors than for regular computer use. They vary in levels of color and resolution quality. Levels EGA (good) and VGA (excellent) are recommended for ADL systems. CGA (poor), Composite (not equipment compatible) and other color monitors (not operations software supported) are not.

MS-DOS software: a software program needed to enable IBM compatible computers to function and to utilize other software programs such as word processors, spread sheets and audiographics (distance learning) operating systems.

Network: a number of distance learning site/systems that are connected and can interact with each other in real time.

One-way television with audio return: television programming or instruction, usually broadcast TV, that is enhanced with a real-time audio or voice communication capability to make the system interactive. Most such systems use a telephone, but two-way wireless FM radio is also being used.

Parallel printer: a computer printer that receives multiple signals (information and commands) simultaneously via multiple wires within the connector cable. It is a more versatile printer than a serial printer.

Real time: live, without delay. A system that can receive a signal, data, or information, then process it, and send output instantaneously is said to be transmitting in real time.

Slides: In this context, slides are the graphics and other computer-generated visuals prepared for use over the ADL system.

Slow scan television: an event or anything videographed ("filmed") with standard video equipment, translated into data and sent over telephone lines. But because the images are translated into a signal that can transmitted over telephone lines, the result is not full motion video. Instead, the video is transmitted as still images or pictures at the rate of one every 20 seconds or so. Usually the individual frames, or still pictures, are sent upon command by the distance learning teacher.

Stylus control pen: Used with a drawing tablet (defined above), the stylus control is a drawing pen that looks much like a ball point pen, but when it touches the drawing tablet it activates electronic circuitry that sends the same kind of information to the computer that would come from a mouse.

Teleconferencing bridge: (see "bridge" above)

Telelearning: another term for audiographics distance learning.

Two-way television: the simultaneous transmission of television in both directions between two or more sites. Both audio and video are concurrently interactive, meaning that students and the teacher can see and hear each other.

232 phone jack: the standard telephone line connector that is used to plug in home telephones. It is a 1/2" x 1/2" x 3/4 " plastic rectangle with a small clip device that holds it in place.

Appendix B: Evaluation of Audiographic Distance Learning

Several evaluation studies have been conducted on the Audiographic System. AT&T, which is a vendor for one system, has conducted studies which focused on instructional effectiveness and cost-benefit analysis of using teletraining. In one study (cited in Chute, Balthazar, and Poston, 1988), adult students were presented with either traditional face-to-face classroom instruction or remote teletraining instruction. The course content and amount of instruction were held identical for both groups. The authors reported that "the post test scores of the teletrained group were significantly higher than those of the traditional classroom group." They concluded that "students appeared to learn from the teletraining mode as well, if not better, than they did from the face-to-face mode." Another AT&T study (cited in Chute, Balthazar and Poston, 1988) , claimed that "teletraining is a cost-effective alternative to face-to-face information delivery."

In the fall of 1988, Far West Laboratory conducted an evaluation of the system, which was being piloted in four schools in Utah's Great Basin region. A total of 33 high school students took distance learning classes in French, English, math, and principles of technology. Table 1 summarizes their assessments of the experience.

Table 1
Student Assessment of Distance Learning Classes
N=33
(5 = Agree; 4 = Somewhat agree; 3 = Neither agree nor disagree; 2 = Somewhat disagree; 1 = Disagree)

	5	4	3	2	1
I feel I am learning from the DL class.	57%	9%	14%	4%	15%
My DL class functions with no more problems than my other classes.	38%	25%	5%	15%	15%
I think other DL classes should be added.	45%	16%	22%	13%	3%

Over 60% of the students agree or somewhat agree with statements about the value of the Audiographic System. However, there were large differences in student ratings

across subjects. The French class received very poor ratings, the technology class received excellent ratings, and others received ratings in between. In short, high school students' ratings about the value of Audiographics appeared to be heavily affected by the quality of instruction and perhaps the subject matter as well.

By far the most comprehensive study on the effects of Audiographics Distance Learning was done at the Pennsylvania Teleteaching Project. Murray and Heil (1987) reported on the results of a statewide evaluation of Audiographics involving 13 courses, 14 teleteachers and 14 receiving teachers working with 103 receiving students and 103 sending students in a total of 24 schools. Courses ranged from Advanced English to geology to Pascal. Student ratings were generally very favorable towards the teleteaching system. Table 2 displays these results.

Table 2
Student responses comparing teleteaching class to regular classroom experiences

Question	Send Site	Receive Site
How well do students learn in the telelearning situation?		
Better than in a regular classroom	18.9%	28.1%
As well as in a regular classroom	57.9%	57.3%
Less well than in a regular classroom	23.2%	14.6%
How much knowledge do you think students acquire in a telelearning class?		
More than in a regular classroom	13.7%	40.4%
As much as in a regular classroom	68.4%	48.3%
Less than in a regular classroom	22.1%	6.7%
How much responsibility do you feel students take in a telelearning class?		
More than in a regular classroom	33.7%	53.9%
As much as in a regular classroom	38.9%	32.6%
Less than in a regular classroom	24.2%	10.1%

How would you rate students' enthusiasm for the telelearning class?

More than in a regular classroom	36.8%	55.0%
As much as in a regular classroom	38.9%	39.3%
Less than in a regular classroom	23.2%	5.6%

How well did the progress of your class correspond to your expectations?

It surpassed my expectations	16.8%	33.7%
It was just about what I expected	46.3%	49.4%
It fell short of my expectations	36.8%	16.9%

How attentive are students when they are being taught via the teleboard?

More than in a regular classroom	35.8%	50.6%
As much as in a regular classroon	34.7%	38.2%
Less than in a regular classroom	25.3%	11.2%

Students from the receiving sites felt that the telelearning situation was as valuable as the regular classroom, they indicated that they learned as well and students felt that under the teleteaching situation they tended to be more attentive and take more responsibility for their own learning.

Teachers' ratings comparing the teleteaching class to regular classes were just as positive. Table 3 displays these findings.

Table 3

Teachers Responses Comparing the Teleteaching Classes to Regular Classes (n=12)

Question	Receive Site	Send Site
How well do students learn in the telelearning situation?		
Better than in a regular classroom	4	2
As well as in a regular classroom	7	8
Less well than in a regular classroom	1	1

Question	Receive Site	Send Site
How much knowledge do you think students acquire in a telelearning class?		
More than in a regular classroom	5	2
As much as in a regular classroom	5	8
Less than in a regular classroom	2	1
How much responsibility do you feel students take in a telelearning class?		
More than in a regular classroom	10	5
As much as in a regular classroom	2	5
Less than in a regular classroom	0	1
How would you rate students' enthusiasm for the telelearning class?		
More than in a regular classroom	10	6
As much as in a regular classroom	2	4
Less than in a regular classroom	0	1
How well did the progress of your class correspond to your expectations?		
It surpassed my expectations	4	1
It was just about what I expected	5	6
It fell short of my expectations	2	3
How attentive are students when they are being taught via the teleboard?		
More than in a regular classroom	9	6
As much as in a regular classroom	3	2
Less than in a regular classroom	0	3

Sending teachers, in general, felt that teleteaching was as effective as a regular classroom. Receiving teachers, on the other hand, tended to favor the teleteaching classroom over the regular classroom.

Much research has yet to be done to determine the educational efficacy of Audiographics Distance Learning. However, the few studies which have been done tend to support the premise that it is a viable technology option for enhancing course offerings.

Appendix C: Distance Learning Users

The following project directors have expressed a willingness to discuss their distance learning experiences with other interested educators. Talking with them will give you valuable information about the advantages and disadvantages of a particular delivery system and may help you avoid problems during installation and program implementation.

Two-Way Television

Using fiber optics for signal delivery:

Mid-State Educational Technology Cooperative,
Russ Johnson, Superintendent, (612) 573-2174, or Jerry Abraham, Director, (612) 573-2177, Upsala, MN 5638

Using coaxial cable for signal delivery:

Sibley County Educational Technology Cooperative,
Dr. John Fredricksen, Superintendent, (612) 237-5511, Gaylord Public Schools, 500 Court Avenue, Gaylord, MN 5533

Using Microwave , Cable, and Fiber optics for signal delivery:

Carbon School District Distance Learning Project,
Eugene Crocco, Director, (801) 637-1732, 65 East Fourth North Street, Price, UT 84501

One-Way Television with Audio Return

Using telephone return:

Central Utah Educational Services Project,
Jack Burr, Director, (801) 896-4469, 545 West 100 North, Richfield, UT 8470

Audiographics

Great Basin Distance Learning Project,
Robert Brems, Member, Administrative Committee, (801) 723-5281, Box Elder School District, 250 West Second South Street, Brigham City, UT 84302

Pennsylvania-Utah Telelearning,
Dr. Dennis Wydra, (717) 662-4578, Mansfield University, 50 Wakefield Terrace, Mansfield, PA 1693

Dr. Henry Jolley, Superintendent, (80[illegible]) 654-0280, Wasatch School District, Heber City, UT 8403

Dotti Hajdu, Teleteaching Project, Riverview Intermediate Unit, R.D. 2, Greencrest Dr., Shippenville, PA, 16254

Dr. Dennis Jensen, Superintendent, (605) 356-2606, Elk Point Public Schools, Elk Point, South Dakota 57207

Lynn Carlsguard, Director Telecommunications, (605) 622-2437, Northern State University, Aberdeen, South Dakota 57401

Don MacCullough, General Manager Communications Services, (305) 995-[illegible]59, Dade County Public Schools, 172 N.E. 15th Street, Miami. Florida 33132

Dr. Bruce Barker, Associate Professor of Education, (808) 293-3885, Division of Education, Box 1954, BYU-Hawaii Campus. Laie, Hawaii, 96762.

Appendix D: ADL Software and Hardware Vendors

The following are contact addresses and phone numbers for the audiographic vendors listed in this guide. Included are price quotes and estimates obtained from three vendors, TSN Systems, Inc., AT&T and AGS. This information is current as of August, 1990.

AT&T
Communications Planning Center
50 Fremont Street, 40th floor
San Francisco, CA 94105
(415) 543-9230

AGS (Educational Technology & Consulting)
306685 Alberta Ltd.
R.R. #3
Innisfail, Alberta
Canada TOM 1A0
(403) 227-1463

Optel Communications Inc.
322 Eighth Avenue
New York, NY 10001
(212) 741-9000
(212) 741-9004 FAX

TSN Systems, Inc,
616 Spring Lane
Boiling Springs, PA 17007
(800) 635-1842
(717) 697-3868 FAX

TSN Systems, Inc.

Software Operating Systems (only one needed):	
Computer Aided Teaching (CAT), per site	$1,000
Computer Aided Conferencing System (CACS), per school	$2,000
Sumagraphics' SumaSketch Plus drawing tablet	$600

Phone conferencing systems (only one needed):

Harvard Telecommunications "Elite" (open/push-to-talk microphone, amplifier and speaker)	$645
Phone Beam (wireless microphone and speaker box)	$450

Other equipment needed (from any vendor):

Computer with 40 MB hard disk, 2 serial ports and EGA or VGA card (cost is approximate)	$2000
EGA or VGA display monitor	$400/$500
facsimile machine	$1000

Optional equipment:

Scanner, Chinnon DF 3000	$750
mouse	$75
laser (video) disk player	Prices Vary

Average Cost per System (One Site) **$6.000**
This can vary several hundred dollars depending upon equipment desired.

At&T Overview Scanner

Software Operating System

Scanware 1.6 (including Baud Bridge Modem)	$1475

Scanner, AT&T OVERVIEW Scanner	$1475

Phone Conferencing System (from any vendor):

Harvard Telecommunications "Elite" (Open/push-to-talk microphone, amplifier, speaker)	$645

Other equipment needed (from any vendor).

IBM Compatible 286 computer with VGA color capability, 40 MB hard disk, 1 MB RAM, 2 Serial ports, and 1 High density floppy disk drive (cost is approximate)	$3000
VGA Display monitor	$500
facsimile machine	$1000
Drawing tablet (most brands, but be concerned with compatibilty)	$600

Optional equipment:	
laser (video) disk player	Prices Vary
VCR	$350
video camera and digitizer	$600
mouse	$75
Panasonic Picture phone	$600
Average Cost Per System	**$8000**

This can vary several hundred dollars depending upon equipment desired.

AGS Audiographic Teleconferencing System

Software	
MS-DOS View Transmission System 1.9	$1215*
MGE Page Creation System	$610
Traymaker V. 1.0	$80
Instalware V. 1.4	$60
Phone Conferencing System	
Alphanet Teleconferencing Hardware: MS-DOS Version AGS 7 Audio Graphic System (w/ 4 microphones, cables)	$2260*
Other equipment needed (from any vendor):	
Computer with 40 MB hard disk, 2 serial ports and EGA or VGA card (cost is approximate)	$2000
EGA or VGA display monitor	$400/$500
facsimile machine	$1000
Compatible Graphics Tablet	$607
Optional equipment:	
Compatible Mouse System	$120
Average Cost per System	**$8200****

* Lower cost when 20 or more purchased
** There may be import duty costs.
Note: AGS will be releasing an audiographics system for the Macintosh in October, 1990.

Appendix E: Reference Material

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Gardner, M.K. and Della-Piana, G. *Learning Over the Telephone Lines: A Formative Evaluation of Tele-Learning in the Northeastern Utah Educational Services Area*. University of Utah, Salt Lake City, UT. No Date.

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